EATING AND DRINKING

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THE ALKALINITY OF THE BLOOD, THE
TEST OF FOOD AND DRINK IN
HEALTH AND DISEASE

BY

ALBERT HARRIS HOY, M. D.

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TABLE OF CONTENTS

INTRODUCTION.

> " Moderation is the best temperance;
> Temperance is the best diet; and
> Diet is the best doctor."
>
> —LORENZO THE MAGNIFICENT.

The importance of diet to health and well being has long been recognized, and writers, from the days of the early philosophers to the present time, have dwelt upon it. Unfortunately, however, during all these years no one has formulated an accurate statement of what constitutes wholesome diet. The saying that "one man's food is another man's poison," is but the expression of the impossibility of fixing a rigid dietary for civilized man in his present condition; but it is still possible to determine what elements in food and drink are likely to be injurious to some individuals or to all.

It is apparent that to just the extent that man eats and drinks what nature has adapted for his use and equipped him to make use of, to just that extent is he free from digestive disorders and diseases resulting from mal-nutrition. This is exemplified in the splendid physique of the native tribes of various lands. On the other hand, civilized man suffers so much from diges-

tive disorders, induced by dietetic errors, that large books are devoted to the especial consideration thereof. The subject of dietetics covers a wide field, and a review of some points which must be borne in mind in connection with it is necessary before proceeding further.

Animal life is broadly divided, according to the kind of food the different varieties subsist on, into the carnivorous, the herbivorous and the omnivorous classes. On examining pieces of the red flesh from animals living on different varieties of food, the composition and structure are found to be the same, and give no indication of the food on which the animal has sustained life. But an examination of the excretion from the kidneys will indicate at once the food of the animal furnishing the excretion. Proper excretion of waste products by the kidneys depending, then, on the food taken, it follows that it is necessary to health that each variety of animal should have its natural food. Animals are guided by instinct in the selection of proper food, and hunger is the sensation which impels them to seek it.

In the most highly civilized condition of man we find that, although instinct does not guide him, he has not availed himself of his higher power of reason, but has permitted appetite and the pleasures of the palate to govern him in eating and drinking. Want of knowledge as to what constitutes the proper form and combination of food and drink is, possibly, the source of

this grave error. Appetite is largely the result of habit and, no doubt, of hereditary influences. It is admitted that digestive disorders are certainly hereditary, and many persons, therefore, are suffering from the dietetic errors of their fore-fathers. Hence healthful fitness in eating and drinking is one of the important factors in the problem of preventing the deterioration of our race. We have a duty in this matter, so to regulate our diet as not to leave dyspepsia as a legacy to our children.

Man is assigned to the class of omnivorous animals, because able to live on either animal or vegetable food, or on a mixture of both. But man, unlike the animals, who drink only water, is omnivorous in drinking as well as in eating, and here arises a condition which we may say nature never intended. Whatever form of food different animals may be impelled to eat to satisfy hunger, water is the only drink they take to slake thirst. Concerning an animal, then, it is only necessary to say what its natural food should be, but in the case of civilized man, we must add to the consideration of the question of eating the consideration of that of drinking also.

Inasmuch as man lives under so many different conditions and the energy he is called on to expend varies so greatly in degree and kind, it is necessary that these different factors be taken into account in deciding what his system requires for its proper nourishment. The question of

eating and drinking, then, instead of being a general one, becomes an individual one. That this is true is evident from the idiosyncrasies and hereditary influences constantly observed. Books on dietetics, however, are not founded on this truth, but specify that man should take just so many ounces of proteid, so many of fat and so many of starch. With healthy men performing the same amount of work this might be practicable, but not otherwise. The failure of any rule like this is inevitable. It reflects only the chemistry of digestion as worked out in the laboratory, and though the information thereby gained is very valuable and constitutes an important aid in applying general principles, it is not the equivalent of life-sustaining digestion.

The true test of a food is not alone its digestibility, but its adaptation to the capacity of the individual using it not only to digest, but to assimilate it, and also to excrete properly the waste matter formed from it. These points can only be determined in detail by studying the needs of the system of the individual, taking into account, at the same time, the condition of the digesting, the assimilating, and the excreting organs. That digestion, assimilation and excretion all belong to the subject of dietetics is now apparent, and the want of accurate knowledge on the subject is painfully manifested, for we find dietetic directions generally given as follows: "Take easily digested food";

"Eat light diet"; "Eat what your stomach craves"; "Avoid rich food", etc., etc. The folly of such vague generalities is plain. The subject should be treated by determining the exact effect of each single element or principle in food and drink upon the blood and excretion in various conditions, in health and disease. If years of observation and study add but a single fact to the sum of knowledge on this topic the time will have been well spent.

It ought to be possible to formulate a dietary as accurate, as to its substances and combinations, as a medical formula, and there is no reason why accuracy and exact knowledge should be required in the latter more than in the former. In fact, food and water are the bloodmakers and drugs are not, hence it is but reasonable to affirm that proper diet must both precede and attend medication.

During an experience of thirty years in active practice the writer has had his attention directed to certain conditions of the system induced by the ingesting of various substances, and in searching for the cause, was led to make a series of tests and experiments on the effect of acid on the secretions and excretions, and he offers these as a first step toward putting the subject on a firm foundation. How little is known of the exact effect of acid on the animal economy, would surprise any one not familiar with the literature of the subject, and much of that which is

stated in books will be found to be erroneous. The general statement, so often made, that vegetable acids are converted into alkaline carbonates and so excreted by the kidneys, is far from covering the whole ground. The writer has not attempted to explain the chemistry of the action of acid on the animal economy, but has carefully recorded its effects in very many cases of health and disease.

That the blood and excretions are affected by different forms of food has long been admitted. The study of the secretions and excretions, therefore, as throwing light on pathological and abnormal conditions in the body, is submitted to be the proper method by which to attain to accurate knowledge as to the needs for nutrition and of the kind required. More than this, it will also indicate whether the food is being taken in proper quantity, and is being thoroughly utilized in generating heat and motion in the animal body.

As a matter of fact, urine is the ashes from the animal furnace. It is the only true excretion from the body. The engine fireman determines by the ashes from his grate, whether he is using the proper fuel, whether it burns economically and gives the best results. So we should be able to determine by the ashes (the urine) from the human furnace its proper fuel (that is, food), and the amount adapted to the needs, the work, and the conditions as to health or disease of each indi-

vidual. Faulty excretion by the kidneys is now admitted to indicate the ingestion of an improper kind or quantity of food or drink, some derangement of digestion or assimilation, or the poisoning of the system by toxic principles, which may originate in the contents of the alimentary tract from putrefaction or chemical changes taking place there, or which, on the other hand, may be generated in the animal tissues themselves. In short, by an analysis of the urine knowledge is gained which is valuable in the treatment of disease of all kinds; and, what is of far more importance, it is possible to be forewarned by the knowledge thus acquired, so that a diseased condition may be prevented. The remarks on the urine and its different reactions are given here simply as the writer finds them by the methods he pursues. He has not taken up the subject of the action of the mineral acids, but has confined his observations to the vegetable acids; and having recorded the effects of their use in many cases both of health and disease, gives the results arrived at without a tiresome enumeration of specific instances.

Dr. J. B. Haycraft, who made an exhaustive study of the alkalinity of the blood, as quoted by Prof. Jaksch in his work on Clinical Diagnosis says: "The reaction of the blood in different conditions may vary as widely as that of the urine."

The writer confirms this view entirely, and as

the result of investigation, has found that THE VARYING REACTIONS OF THE URINE SHOW THOSE OF THE BLOOD, and thus afford an easy and accurate means of determining its condition. He therefore earnestly entreats physicians to carry on the study of the alkalinity of the blood, affording, as it does, a guide to the proper food and drink, or medication, in all forms of disease. It is an accurate guide when the question of accuracy or inaccuracy may determine the issue of life or death. In a multitude of tests by a number of observers something must be learned. If the following pages shall contribute any useful facts as to the effect of different substances on digestion and the blood; if attention shall be called to the subject and other investigators be led to make further and valuable discoveries; or if any one suffering from digestive disorders shall be enabled to correct what is wrong by following the advice here given, the author will feel that he has accomplished something worth the effort. A. H. H.

103 State St., Chicago.

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CHAPTER I.

AIR, WATER AND FOOD, AND THE RELATION OF VEGETABLE TO ANIMAL LIFE.

Three things are essential to life: air, water, and food; and the order in which they are named expresses their relative importance to life. Without food, life can be sustained for a considerable period; without both food and water, the period is far shorter; deprived of air, the duration of life, in its higher forms, is only a matter of minutes. Who has not seen the green field, a thing of beauty, changed in a few days, under the influence of drought, to a burned desolation? With the coming rain, behold the transformation! In a few hours all is again green and life is apparent in a myriad of forms. The roots of the grass, though surrounded by soil containing a full supply of proper food, were perishing, not from hunger, but from thirst. The life-giving power of water is most significantly exemplified in the history of irrigation on our Western plains. Soil, once supposed to contain

none of the elements of plant food, when supplied with water from an artesian well or a mountain stream, is covered, at once, with most varied and luxuriant forms of plant life. The importance of water over food, to animal life, perhaps requires no demonstration. In all so-called famishing tests undertaken by men, it must be remembered that water has never been withheld ; no one has yet had the temerity to attempt a thirst test. Succi, the Italian, who in 1890 undertook an absolute fast of forty-five consecutive days, drank what amounted to twenty-five and a half ounces of water per day during the whole time. Accounts of shipwrecked mariners tell us that the sensation of hunger gradually increases, becomes extreme, and, after the lapse of two or three days, slowly diminishes; while that of thirst becomes hourly more imperative, and soon develops into unbearable agony. Coleridge in his "Rime of the Ancient Mariner," makes the suffering there depicted dependent upon the lack of water and not of food. His description is both terribly realistic and scientifically accurate.

> " With throats unslaked, with black lips baked,
> We could not laugh nor wail;
> Through utter drought all dumb we stood!
> I bit my arm and sucked the blood,
> And cried, 'A Sail! A Sail!'
>
> And every tongue through utter drought
> Was withered at the root,
> We could not speak, no more than if
> We had been choked with soot."

The physiological manifestations of the sensations of hunger and thirst are marked by sharp distinctions. Deprived of water, the blood, to maintain its fluidity, takes this fluid from the lymph spaces, cells, and neighboring tissues. Emaciation follows quickly and to an excessive degree. The suffering becomes intense, followed by prostration, delirium, coma, and death in one of its most agonizing forms. Without water, life may be sustained for from two to seven days, according to modifying circumstances. Deprived of food under otherwise similar conditions, life is prolonged for from seven to forty days.

The sensations of thirst are experienced in the mouth and pharynx, being attended by a dryness of these parts. The sensation of hunger is commonly referred to the stomach, and is generally described as a gnawing at the pit of the stomach. It is a common expedient of hungry soldiers to tighten their waist-belts, with the effect of temporarily relieving discomfort. It is also found that a little alum, taken into the stomach, abates the sensation of hunger during the action of the drug, which is simply that of an astringent. These expedients, however, in no way suppress the sensation of thirst, even for a time. Water, and water alone, will quiet this imperative demand of nature. Food does not slake thirst, and water does not abate hunger. We say, when hungry, that the "mouth waters" for food, but when thirsty, that the mouth is parched.

Hunger indicates a deficiency in the varied and complex solid elements of the blood. Thirst signifies that the blood requires water alone. It has been found that in certain forms of insanity there is no hunger, or desire for food; water, however, is always called for in these cases. Grief and anxiety hold the desire for food in abeyance, but thirst asserts itself under the same conditions. Again, in almost all forms of illness the loss of appetite is the first symptom. Thirst, however, is often augmented. All these facts plainly show that different nerve centers must be the seat of these sensations.

It is a popular belief that the rabbit and the kangaroo require no water. This is an error. They simply get enough of this liquid in the watery vegetables upon which they feed. Let them be put upon dry food alone, without water, as has been done, and they soon perish.

Two very important facts, showing that water performs a chemical action in animal digestion independent of its power as a solvent, will probably be accepted as sufficient to prove that water cannot properly be classified as a food.

First.—Water does not undergo any chemical alteration in digestion, and liberates no force, nor does it produce any heat, as do true foods; on the contrary, its office is directly the opposite, in that it is the heat remover and reducer.

SECOND.—Water, in digestion, may perform the office of either an acid or a base; for food is first hydrated quickly and completely by the action of the digestive agents. Albumen, for example, when subjected to the prolonged action of superheated water alone, forms a compound which resembles in a most remarkable degree, that formed from it by animal digestion. So it is scientifically accurate to say of albumen, that, by digestion, it is converted into a hydrate of albumen, and this is equally true of other foods of this class.

The author of a well known work on food, in discussing this point, says: "Popularly, the ingesta are looked upon as consisting of food and drink, the one supplying us with solid, the other with liquid matter. Superficially, this appears a natural and convenient mode of primary grouping, but from a physiological point of view it is completely worthless. 'Food' and 'Drink' constitute terms referring to the particular state in which an article for consumption may happen to exist, namely, whether it is in a solid or a liquid form. Physiologically, then, the separation of the ingesta into 'food' and 'drink' is unsuitable. The two material factors of life are food and air; and food may be considered as comprising that which contributes to the growth and nutrition of the body."

It is believed that it is necessary to modify this view, more especially as all other writers

on the subject seem to have blindly adopted it as true. The first statement, concerning the ingesta, should be corrected to food and water, and it is apparent, from a physiological point of view, that the distinction then embodied is a natural and accurate one, and most happily suitable. Eating and drinking simply refer to certain kinds of muscular action; any solid matter and any liquid may be taken into the body by eating and drinking. Drink, as the author correctly says, is only a condition of a substance, but it need not necessarily be a food, it simply implies a liquid condition. We can drink sulphuric acid, ammonia, or alcohol, none of these being foods in the slightest degree.

The second statement, that there are "two" material factors of life, should be changed to read "three"; for there are three factors of life—air, water and food, as we have shown; and the animal sensations calling for supplies of these are termed suffocation, thirst and hunger. Thirst and hunger are just as physiologically different, and marked by as distinct nerve origin and chemical action, as are hunger and suffocation. Any classification of foods into solid and liquid is of the kitchen, and belongs to cook books. Any division of alimentary substances that classes water as a food is inaccurate and unscientific for the following reasons:

FIRST.—All food must be submitted to a change in its molecular arrangement through a

process called digestion, before it can be assimilated by animal life. Water is not thus changed in the animal body, but is directly absorbed unchanged, and unchanged leaves the body.

SECOND.—Water, as has been shown, performs a chemical part of its own, causing the hydration of foods, but cannot itself be hydrated.

THIRD.—Hunger and thirst are under the control of separate nerve centers.

FOURTH.—All food must be regarded either as a tissue builder, or force and heat producer. Water effects none of these changes, but, on the contrary, its office is to reduce and remove heat from the animal bodies; it is, in short, the heat controlling agent.

The definition of food given by the same author, which also seems to have been generally accepted by succeeding writers, is: "Food is that which contributes to the growth and nutrition of the body." This is a most unscientific and inaccurate use of terms. The oxygen of the air is of vital importance to the growth and nutrition of the body, but it cannot be classified as a food, as it does not enter by way of the alimentary canal. Exercise, also, is a factor in growth and nutrition, and therefore is a food according to this definition. Such carelessness and want of accuracy in classifying and defining food, has caused much confusion in discussing this subject.

The true definition of food is simply this: Food is that which satisfies hunger and replaces

the solid waste of the body. Its correlative, water, is that which slakes thirst and replaces the fluid loss of the body. The attempt is made to explain too much on purely chemical grounds, while it is the mysterious life-giving principle of which we know nothing, that is at the bottom of these subtle changes. The chemistry of life and the chemistry of the laboratory are by no means interchangeable, for experiments made in the latter are comparatively useless as demonstrating what takes place in the digestive system. True knowledge in this matter is only to be acquired by noting the effects on normal man of various foods taken for a protracted time, their effect on nutrition, and the pathological and physiological conditions induced thereby. We may find that these are accompanied by some simple chemical reactions in the fluids of the body which will aid us, but an attempt to explain all the chemical changes of digestion must end in confusion and inconsistency.

We come now to the discussion of nutrition in general.

All life is sharply divided into two forms, vegetable and animal, which, standing opposed to each other, but each dependent upon the other, may very aptly be compared to the diametrically opposite points of a circle, each opposed to each, yet inseparably connected. Recognizing this antagonism, we may expect to find a har-

monious law of contraries existing in these two forms of life. Differences easily recognized in the higher forms of life must be as essentially distinct in the lowest. The assertion that vegetable and animal life overlap, or are indistinguishable from each other must be modified into the statement that to our feeble vision they so seem. For if we fail to find this antagonism in all cases, it is simply due to our lack of facilities or powers of observation. We know that the telescope has its limitations. When we attempt to peer into space we think we may infer from what we do see, that which we do not see. So, the microscope has its limitations which cut us off at the very threshold of our investigations, but it takes us far enough to warrant us in recognizing the antagonism of the two forms of life.

We notice first that the food of plants is mineral matter; that of animals is vegetable and animal in its nature. In other words, at the moment of assimilation and utilization, the food of one must be in that chemical condition expressed by the term inorganic,—that of the other in that called organic. True, plants are fed by decomposing vegetable substances known as mould, or by waste matters of animal life called manure, or by saline matters called fertilizers, but in whatsoever form we apply any of these materials to the nourishment of plant life, it is only when they are converted into their inorganic forms that the plant is able to assimi-

late them and be thereby nourished. Chemically, the organic forms of nitrogen, phosphorus and sulphur are converted into the soluble nitrates, phosphates and sulphates, by union with oxygen or hydrogen, and are thus rendered assimilable by plant life.

How then, are these substances made ready for the use of the plant? It is to the roots of the plants that we have applied these different foods, and there we must look for the solution. We find there nothing analogous to the digestive organs of animals, and no process that can be called digestion. Here we encounter one of the grandest discoveries of modern science, one which, alone, renders the name of Pasteur immortal. He proved that vegetable life is dependent upon the action of microbes, whose office it is to transform organized compounds into their unorganized state, and thus make ready for assimilation, by the plants, those substances necessary for their nutrition. They break down the organic material in the soil, and are more necessary to plant life than anything else. This transformation is known as mineralization. Some plants have been found to have a special kind of germ, which is attached to their roots in the form of tubercules, and which has the power of abstracting nitrogen from the air for use by the plant. How far other plants may be dependent on special varieties of bacteria in the soil has not yet been determined, but we may assume that the science of agricul-

ture is, from the bacteriological standpoint, yet in its infancy. Theoretically the farmer of the future will fertilize his fields with water containing myriads of the special germs necessary to the growth of the plant he desires to rear. And just here, we may note this important point. This change in the chemical condition of plant food, takes place outside of the structure of the plant.

On the other hand, the food of animal life is organic matter, prepared for assimilation and nutrition inside of the animal body itself, by the action of certain fluids called digestive, and by a process termed digestion, through which different organic compounds are rendered susceptible of assimilation and capable of furnishing material necessary for the growth and repair of the tissues of the animal system and for the generation of heat and force. And here may be noted what might be assumed, at first thought, to be exceptions to this law. Botanists assert that the pitcher plant, the sun dew, the Venus fly trap, and others belonging to like classes, are insect eating and digesting plants. The simple fact is that the insects are caught in the trap-like, water-holding, sticky, or closing leaves, and there undergo decomposition by the agency of microbes, until their inorganic constituents are absorbed by the cells of the leaves, instead of by those of the root. Note here, also, that plants assimilate their food by the roots, and breathe with their leaves,

and hence the inorganic matters taken in through the leaves cannot properly in any case be called food. It is submitted that investigations made twenty-five years ago must be reviewed and qualified by recent observations. First, it must be remembered that a substance capable of acting upon or dissolving certain albuminoid substances, found in the structures of some of the so-called insectivorous plants, is not found in all this class of plants, and these very exceptions at once prove the absence of any necessary use of this substance as a digestive fluid. And, besides, it is now well-known that juices having this power of dissolving albuminoid substances are found in very many other plants. The juice of the pineapple contains an element called bromelin, which has this power in a marked degree. The papaw of India also contains it, and the active principle papain is used as medicine to aid in dissolving organic substances. In its native country, the natives are said to soften meat and make it tender simply by wrapping it for a short time in papaw leaves. Neither of these plants can be classed as insectivorous, and the presence of albuminoid-dissolving juices, which seem to be possessed by very many plants (how many we know not), does not imply anything like digestion as appertaining to plant life.

Anyone who has ever found the pitcher-plant in its native bog and taken notice of the putrefying mass of water-soaked insects in its lethal

vases will at once recognize the plain work of microbes and will admit that this is in no sense digestion.

It is asserted on the other hand, that many of the lower forms of animal life among the protozoa,—the amoeba, for instance, have no stomach. But in this case the whole outside membrane exercises the function of a stomach, called into action by the animal folding itself about the food to be digested, thus forming a closed, pouch-like, extemporaneous stomach, which is truly on the inside of its own body. This furnishes a striking example of what was asserted previously, that animal life digests and assimilates its food on the inside of its structure.

Let us seek in nature forms of animal life, still on the lowest plane, but of a size that enables us to recognize their life-habits and movements. Bring into the microscopic field the simplest enterozoa. Here we find two cells for the first time, each functionally and structurally different from the other. The outer one forms the body wall; the inner one constitutes the digestive cavity. These are entirely independent of each other in their structure and uses. The food which is solid matter passes through the outer wall of the body through that which serves as a mouth, and is taken into the simple one-celled stomach in the center of the body and there digested. We can also easily determine

that their food is organic matter, as we see them feeding on vegetable protoplasm, or savagely swallowing their fellow-creatures. All this detail is presented to sustain the assertion that the vegetable and animal kingdom are sharply divided. The food of each being exactly the opposite of that of the other, an anatomical and physiological difference in structure is required.

Having then found that every form of animal life, from the lowest to the highest, is provided with a stomach, it becomes thereby evident that all food must enter through the digestive system, and that digestion is an indispensable condition of its introduction into the blood circulation for the purposes of nutrition. In the case of man, interesting experiments have been made confirmatory of this universal law. Milk, eggs, sugar, and foods in the last stage of digestion, have been injected into the blood, and not only did they fail to contribute in any way to nutrition, but acted as poisons in many cases, or were found in an unaltered condition in the urine. Water, however, may be freely injected into the veins, and thirst is thereby relieved, and indeed all the important functions which water performs in the body are performed as well as though the water were swallowed. It is interesting to note, furthermore, that if the saline, or mineral elements of food be added thereto in a proportion greater than in the natural combination (such as the phosphates or chlorides), with the idea of

making the food more nourishing, the result is a complete failure, as all the substances so added in their isolated state, are at once eliminated from the system by the kidneys unchanged.

Recognizing again the antagonism between vegetable and animal life, and having just determined that microbes are essential to vegetable life, we are justified in inferring that they are not necessary to animal life. This may seem to conflict with statements made by others, for writers on the physiology of domestic animals say that certain microbes play an important part in breaking down the cellulose in the digestive system of the herbivora. In the cases of the ruminants, or four-stomached animals, we must remember that the action of the first three stomachs is preparatory to digestion. The first three pouches (as they may be called) serve only to store the foods and liquids, and secrete no digestive fluid of their own, while in the fourth alone, true digestion takes place. The statement that the changes in the first three compartments of the stomach of the ruminants, are without analogue in the gastric digestion of the single stomach animals, needs modification. The first stomach, or rumen, may be considered as a non-masticating mouth, for the food here receives the action of the saliva and a thorough mixing. The starch-producing power of the saliva seems to be of no fixed value, being almost absent in the goat. In these preparatory stomachs cellulose

is said to be digested through a fermentive process, which of course is due to microbes. Mark, however, that this fermentive action must be checked when the food enters the fourth stomach of the ruminants, or the single stomach of the other herbivora, by the germicidal action of the gastric juice. That is, the germs themselves must be digested and their action stopped or else that condition so fatal to domestic cattle and horses, known as colic supervenes. This is simply an over-distention or bursting of the stomach or bowels, as a natural result of the great volume of gases which are always set free by the mineralizing of organic matter by microbes.

Let us bear in mind, besides, that all these experiments have been made on domestic animals, in which the natural condition is so much changed that the observation can hardly be said to be very valuable. It must be taken into account that the cultivated grasses with which these experiments have been conducted, represent in themselves forced conditions and differ entirely in composition from the wild grasses which natures provides. The animal, too, is living under abnormal conditions, with entire suppression of the guidance of instinct, so that digestion, even, cannot be said to be normal, for we are not sure that we have provided it with its natural food. It is submitted therefore, that it is very doubtful whether, in a wild state, the same phenomena would occur

in digestion as occur in the state of domestication.

Let us call attention here to the baleful effect on the health of cattle caused by feeding them the fermenting, microbe-laden distillery grain, and also to the proneness of swill-fed hogs to cholera and other diseases. The rapidity with which the flesh of such hogs taints and spoils, is well known. It is in marked contrast in firmness of texture, in color, in flavor, and in keeping qualities, to the pork of corn-fed swine. That the flesh of the first is manifestly unclean and unfit for human food because it decomposes in the stomach before digestion can take place, is an established fact. Certain it is that we are justified in saying that in the single stomach animals, especially man, whom we are considering, it has not been and cannot be shown, that microbes or organized germs can or do perform any good office, or in any way aid digestion or assimilation of food.

Important testimony bearing on this point was furnished by the very elaborate experiment made by Geo. H. F. Nuttall, and H. Thierfeld, announced in Hoppe-Seyler's Zeitschrift für Physiologisch Chemie, for November 1895, on "Animal Life Without Bacteria in the Alimentary Canal." Without going into details concerning the care and skill displayed by these observers, in order to avoid all sources of error, it is enough for the present purpose to know that an animal was placed in such conditions that not only was

the food it took sterile, but even the air it breathed was rendered free from germs. After a sufficient time of living in these conditions a comparison was made with an animal of the same age and kind, but which had been left to its ordinary mode of life. The sterile-kept animal was found to be the heavier of the two. This proves what was logically to be expected, that the presence of bacteria in the alimentary tract is not necessary to animal life and thus the principle of the antagonism of the essentials for the two forms of life is again sustained.

We should expect then, to find that wherever microbes gain entrance to the digestive tract, which in man properly ends at the junction of the small intestine with the colon, they would interfere with digestion, and that there would be a departure from health and normal conditions, just in proportion to the number and kind of these microbes, varying, it may be, from slight indigestion or biliousness to diseases most fatal in their nature. For, digestion once interfered with, we depart from a condition of health, vitality is lowered, power to resist disease is lessened, and we may become a prey to all the ills that flesh is heir to. Scientific research has proved beyond doubt, that from fermentive dyspepsia to typhoid fever and malignant cholera, including all those diseases known as ptomaine poisoning, the cause is simply, for one and all, the presence of the specific bacteria of the disease

in the alimentary tract, their interference with digestion and nutrition, and the lethal effects of the poisons produced by them.

The action of the normal gastric juice on pathogenic organisms must here be referred to as of the greatest importance. Gamgee, in his "Chemistry of Digestion," makes the following statement, which is so confirmatory of the views herein advanced that it is quoted in full:

"When treating of the influence of changes in the acidity of the gastric juice in disease, its antiseptic action was discussed and it was shown that the acid which it contains exerts a marked influence in destroying putrefaction as well as many of the pathogenic organisms which may find their way into the stomach. In the normal condition, gastric digestion in a healthy man is a process which proceeds entirely under the influence of enzymes, and the fermentations which are the result of the activities of organized ferments must be looked upon as a departure from normality, as indeed, pathological." Just which micro-organisms are destroyed by the gastric juice is the fact that most concerns us now, and the experiments of a long list of observers may be summed up as follows. The bacilli of anthrax and cholera, of typhoid fever, of diphtheria and of tetanus, are destroyed by the hydrochloric acid of the gastric juice secreted in perfect health. Let it, however, once fall below

normal (and the variation necessary is no doubt but small) and the contagium of the disease invades at once the whole system. In the case of the non-pathogenic micro-organisms we have only to remember that acetic, lactic, butyric, and similar fermentive acids react injuriously upon the functions of the stomach, inhibiting digestion and bringing on a long train of dyspeptic disorders, thus really opening the way for the entrance of the pathogenic bacteria. That is, the non-pathogenic germs introduced into the stomach produce abnormal conditions, interfering, as they do, with the secretion of the gastric juice.

Drs. Thomson and Hewlett, of London, have determined that it may be safely said that the dweller in the larger cities inhales an average of 14,000 microbes per hour. This being so, it is plain that this great host must be destroyed by the healthy action of the vital processes within the body, as we know that expired air contains no germs. As long as this vitality is at par or above, these invaders are taken in only to be destroyed, but let the vital tissue-resistance be lowered from any cause; cold, errors in eating or drinking, excess of any kind, in short by anything that reduces the alkalinity of the blood, and the system is then in a condition making it possible for the small, but powerful microbian enemies to work infinite harm.

In truth they are the sappers and miners that open the way for the conquering host of disease

and here is found the true explanation of the different effects produced in the human body by the introduction into it, by way of the stomach, of well known pathogenic bacilli; that of cholera, for instance, with which the experiment has been tried. In the stomach containing gastric juice of a normal acidity, these are at once destroyed and no harm results. If, however, this acidity is only slightly reduced from any cause, and a neutral or alkaline condition obtains, the bacilli are enabled to multiply with inconceivable rapidity. They then invade the small intestines in myriads, and with augmenting numbers soon complete their deadly work. In this case the question of life or death turns simply upon the presence or absence of a normal amount of hydrochloric acid in the stomach. It is then important that they be stopped at the outer gate—the stomach. It is the acid reaction of the secretion of this organ which constitutes its germicidal power, for, below that, all the digestive fluids are alkaline in reaction, and that of the liver is the only one that exercises any germ-destroying action.

The importance of preventing, as far as possible, the entrance of microbes into the intestinal tract, or at least preventing their accumulation there is strongly emphasized, when we consider the pathology of that serious disease, appendicitis. Dr. Manly of New York says: "The active element, supreme here as an etiological factor, is germ infection." Eckhorn has shown

that, of the numerous varieties of bacteria in this disease, the bacterium coli commune holds a foremost position; while Barbacci, of Florence, alleges that more slowly growing forms of microbes, and less conspicuous, may cause perforation of the appendix.

As we have said before, the digestive tract in man ends at the beginning of the colon, the lower bowel being simply a receptacle for the waste matter of digestion. This may be found swarming with bacteria and microbes of all kinds and descriptions. Let us not think from this that they come in their living state directly from the small intestines, for the gastric juice, it has been determined, has no effect upon the spores of micro-organisms—disease-making or non-disease-making. These may pass harmlessly through the digestive tract, springing into teeming life in the undigested and putrid matter of the lower bowel; a menace still to life and health, not to the degree, however, that they are in the assimilating organs, yet their ill effects are manifested in the form of ptomaines, which find entrance into the general system through the walls of the colon, though that is not in itself a true nutrition-absorbing organ.

Let us go back a step. We have said that these spores are hatched into life in the putrefying contents of the colon. In a perfectly normal condition, there can be no putrefying contents in the colon, nor should there be any. It is only

when more food has been taken than normal digestion can act upon, or when food has passed unacted upon, by reason of feeble digestion, that material for the most dangerous bacteria of putrefaction is found in the colon.

We may safely say that in a strictly normal condition of the colon contents there should be no putrefactive microbes. As confirming this view, let us call attention to the fact that in infants whose digestion is normal and in animals whose food and digestion are as intended by nature there is no evidence of putrefaction in the egesta, and those fetid substances, indol and skatol, are absent. Their presence there must be regarded as indicating a departure from normal conditions. That they have any physiological office to perform is simply an assertion not born out by the facts; on the contrary they break that consistency which nature never violates.

On this point Küchne and Neucke have proved that indol is exclusively a product resulting from the action of bacteria on albuminoids, and Jaffé, Bauman and others, have shown that all this class of aromatic substances, indol, phenol, skatol, etc., are elaborated in the intestine and eliminated by the urine, thus showing that they must be regarded as toxines, as they are never found in the tissues of the body. Bouchard says in his work on "Auto-Intoxication in Disease," "There is a source of intoxi-

cation for the blood, putrefaction, which the presence of micro-organisms in the intestinal tube incessantly maintains. In the digestive canal the conditions most favorable for the elaboration of poisons are realized, for peptones are most excellent culture-media for microbes. Thus do we find the small intestine, on the one hand, and the large intestine particularly, on the other, capable of passing the products of putrefaction into the blood."

Any physician of experience knows full well that in many diseases the increasing fetor of the fæces is an indication of a corresponding increase in the gravity of the disorder, and as the fetor diminishes and disappears the patient advances toward recovery. It is best to stand on no middle ground in this matter. The distinction between pathogenic and non-pathogenic microbes must be swept away in the consideration of their influence on man's digestion, and all kinds must be regarded as out of place in its normal operation. When we cease to make artificial distinctions, which nature does not make, we can the better determine nature's operations. It being true then, that microbes furnish the one necessary factor in the assimilation of food for plant life, by the very law of antagonism existing between the two forms of life, we are justified in inferring that they are not necessary in the assimilation of food for animal life. By accepting this view, we shall have

gained one point at least, from which we shall be able to harmonize, to a great extent, many of the perplexing contradictions constantly met in the discussion of digestion in health and disease. We must view this matter from the standpoint of the surgeon. He makes no distinctions, but excludes all micro-organisms from the wounds he treats, and in so doing, and by no other means, can he achieve normal results.

Recurring to the antagonism of vegetable and animal life, and yet their mutual dependence, the whole subject of the place and object of microbes in nature has been examined at too close a range, and studied too much in detail, the constant desire being to discover new species, to which there seems to be no limit. The number of these can in no way affect the general law, which may thus be formulated, and which is but another example of the beautiful harmony of nature. *Plants feed upon inorganic matter, prepared for their assimilation outside of the plant itself, by the office and aid of microbes, which are thus essential to vegetable life. Animals feed upon organic matter, made ready for assimilation by a process called digestion, which always takes place inside the body of the animal, and to which microbes are in no way essential or of use, but may be very harmful.* This danger is antagonized by the microbe-killing power of the normal gastric juice, which not acting upon the microbe spores, these latter are thrown off in the

waste substances from the colon, being then ready to start into life, and to effect the necessary mineralization of these waste substances, thus fitting them to be used again by plant life.

"How about the microbes themselves?" may be asked. These alone are the only true self-sustaining forms of life. They are their own microbes, feeding upon a small portion of the matter which they prepare in wholesale quantities for the nourishment of plant life. They simply take toll, as it were. In general the office of microbes is to destroy, that is, to change organic matter into inorganic. So well is their specific place in nature now recognized, that it has been suggested they should properly be termed a third form of life. The office of plants is to create, for they alone possess the power to produce organic matter directly from the inorganic.

Animals feed upon and utilize the substances created by plants, and in the end, their own bodies are resolved into inorganic substances by the kindly offices of the destroying microbe, thus contributing again to the nourishment of plant life. So the balance and the permanency of nature's forces is maintained.

CHAPTER II.

HOW FOOD IS DIGESTED.

The statement made in the preceding chapter that the acid of the gastric juice acts as a germicide, may suggest to many that it may be wise to take into our stomachs an extra supply of acid, that of fruits for instance, and thus possibly aid digestion by destroying harmful microbes. This opens at once the whole subject of the place acids occupy in the animal economy. To study this subject accurately, we will now review what we know of digestion.

When food is taken into the mouth the digestive process has its beginning in the mastication, or grinding and crushing, of the food by the teeth. To this end it is essential first of all, that the teeth should be competent to perform their office, or we shall find that the subsequent processes will be interfered with. Teeth must be sound, free from decay and from decomposing matter. Here we observe the first action of acids in the fact that decay of the teeth is now known to be caused by the corroding power of lactic acid, this being formed, of course, by its microbe. The whole mouth must be in a sani-

tary condition, that is, free from the hosts of microbes which may find lodgment there, or they will be mixed and swallowed with the food, and thus inhibit digestion to an extent many fail to estimate justly. Observations and experiments have been made which prove the deleterious effect on digestion of the microbes of the teeth and mouth. Medical literature contains many cases where severe dyspepsia has been entirely relieved merely by keeping the mouth pure and clean.

While the food is being masticated it is also being moistened with a watery secretion, poured into the mouth from the salivary glands, and known as the saliva. This has first a mechanical office, that of rendering the food moist and slippery, thus forming a mass which can be easily swallowed. In man and other animals it has also a chemical function of great importance. This is due to a substance known as ptyalin, the office of which is to convert the starch in foods into the first condition of a soluble and assimilable form known as maltose, a kind of sugar. Now human saliva is readily procurable for purposes of experiment and observation. Tests have been made many times, and by many students, and the following facts are well substantiated.

FIRST.—It is a feebly alkaline fluid and its ptyalin possesses its normal maltose-making power only in alkaline or neutral media. All acids stop

its action, and with rapidity directly in proportion to their strength. The following experiments made by Dr. J. H. Kellogg are so striking in their results as to justify quoting his report: "Ten C. C. of a one per cent solution of starch were added to ninety C. C. of distilled water at a temperature of 100°, to which mixture one C.C. of the saliva was added. The time for the complete conversion of the starch by normal saliva we found to be four minutes. In determining the effect of the various substances added, a definite amount of the substance was dissolved in a mixture of starch and distilled water before the saliva was added. The other conditions remaining the same. The effect of the substance in hindering starch digestion is indicated by the length of time required for complete conversion.

	Time.
Oxalic acid:	
1-10,000	No action.
1-15,000	35 minutes.
1-20,000	19 minutes.
1-30,000	4 minutes.
Lemon juice:	
1-200	No action.
1-500	42 minutes.
1-2,000	9 minutes.
1-5,000	7 minutes.
Orange juice:	
1-200	11 minutes.
1-500	4 minutes.
Apple juice:	
1-50	45 minutes.
1-200	4 minutes.

Vinegar:	Time.
1-200	No action.
1-500	40 minutes.
Hydrochloric acid:	
1-4,000	No action.

Several points of interest may be deduced from these experiments. A few only will be briefly mentioned:

1. Acids of all kinds inhibit the diastatic action.

2. The normal degree of acidity of the gastric juice; namely, one part to 4,000 of stomach fluid is sufficient to completely inhibit the action of saliva.

3. The greatly less, yet distinct action of the acids of sour fruits in hindering the action of saliva upon starch, explains why many persons with weak digestion are unable to take acid fruits in connection with farinaceous foods.

Just here it may well be asked; "If it is proven injurious for a person with weak digestion to take acids with bread and other farinaceous foods, how long may a person with so-called strong digestion take acids, and thus interfere with nature's normal processes, without deleterious results?" Nature in these matters is very patient and tolerates a deal of interference with her normal functions. Pathological changes, however slow their manifestations, are nevertheless sure to make themselves known sooner or later.

Attention is called to a physiological fact concerning saliva, which it is important should be constantly borne in mind. It is that the saliva of infants contains a small amount of ptyalin, and hence they cannot readily digest starchy foods. Such substances are therefore very prone to fermentation in their stomachs, causing serious gastric and intestinal disorders.

After mastication the food is swallowed and enters the stomach. Normally we find this free from acid during the process of eating. The stomach under these conditions is simply a receiving organ, with some mixing and triturating motions added. The purpose of all this is evidently to give time for the continued action of the saliva upon the starch, begun while in the mouth, and which must of necessity be operative there only during a very limited time.

Dr. J. H. Kellogg made several thousand examinations of stomach contents after a test meal, and found that from half to three-quarters of an hour was occupied by the saliva in the stomach in effecting the digestion of the starchy foods, before the acid secreted by the stomach stopped this action. It is to be observed here that by this arrangement man, with his one stomach, has to some extent the functions of an animal with a multiple stomach, and interest in this matter is further enhanced, when, on studying the anatomy of this organ, in the single-stomach animals, it is found that in many of

them the rudimentary folds and the arrangement of glands still remain, indicating a true process of evolution and an adaptation to special foods.

The single stomach of the common rat is almost divided into two chambers by these folds, and this animal is one of the few that may truly be called omnivorous. Given, then, only the stomach of an animal; by investigating these more or less marked features in it, it would be quite possible to name the proper food for that animal.

The stomach is now ready to take up its own specific function in the digestive process, namely that of digesting the albumen of food (the so-called albuminoid substances, or as they are now generally termed, the proteids), and its action is the same on these, be they from the animal or vegetable world. This consists in converting them into a soluble and assimilable form known as peptone. To this end the glands of the stomach furnish an acid, and also a digesting substance. The nature of this peculiar acid was for a long time undetermined with accuracy, so difficult is it to exclude in tests made with gastric juice the different acids introduced with the food or resulting from fermentive changes in the stomach contents.

The history of the subject dates back two centuries, when in 1695 Bédévole declared that "the ferment of digestion is composed of acid, alkali, and phlegm." Bédévole detected in the

gastric juice an acid, and later observers have, from time to time, found acids in it. At the present time light has appeared from a conflict of ideas, and there is agreement upon this point. The normal acid of normal gastric juice is hydrochloric acid alone, secreted by the stomach itself, in the proportion of from one to four per thousand. The presence in the stomach of organic acids, such as lactic, butyric, acetic, etc., is merely an evidence that they are there formed as the result of the special microbe causing fermentation in the food, but they have no place in the normal human stomach, nor are they in any way connected with normal digestion. The specific digesting substance secreted by the stomach is known as pepsin. This substance is easily procured and we are able to make laboratory experiments with it, furnishing much information both as to what aids and favors and what antagonizes this part of digestion. The first experiments made consisted in testing the action of pepsin when in alkaline or neutral solutions. The result of all these tests was uniformly that in such alkaline or neutral solutions, pepsin had no action whatever. Proceeding then to consider the action of acids when mixed with pepsin, reference is made to a very exhaustive article, "Contribution à l'Étude de la Valeur Digestive des Acids," par M. J. Thoyer, which appeared in the "Comtes rendus hebdomadaires des séances et mémoires de la Société

de Biologie," series 9, Vol. 3, 1890, Paris. Dr. Thoyer says, "The acids to which our researches were directed were hydrochloric, sulphuric, nitric, tannic, tartaric, oxalic, citric and acetic. The pepsin which we used was perfectly pure. We satisfied ourselves that, by itself, it had not the power of peptonising. Our researches were made in the following manner: in a series of test tubes we introduced ten cubic centimeters of the aforesaid acids in solutions varying in strength from four to thirty parts per one thousand; to that we added two centigrams of pure pepsin and a one gramme cube of white of egg. These tubes, corked with a very tight little stopper of cotton, were put into hot air, where we left them twenty-four hours, at a constant temperature of from thirty-seven to thirty-eight degrees C. At the end of this time, during which, on several occasions, the tubes had been shaken, we observed the following results:

1. Solutions of 4 to 5 per 1,000.	Digestion seemed to have begun only in the Hydrochloric acid tube.
2. Solutions of 10 per 1,000.	Very decided digestion in the Hydrochloric acid tube;—only begun in the tubes with sulphuric, acetic, oxalic, tartaric, and citric acids.
3. Solutions of 20 per 1,000.	Digestion less decided for the HCl. acid tube; — very clearly marked in the tubes with digestions of sulphuric, acetic, oxalic, tartaric, citric and tannic acids; only begun in the tubes with lactic acid digestion.

4. Solutions of 30 per 1,000. { Digestion much less clear in HCl. ;—begun and more or less advanced in all other tubes.

From all the preceding we believe ourselves justified in drawing the following conclusions, as the result of our experiments:

1. Hydrochloric acid is the acid which mixed with pepsin is the most fitted to transform albuminoid substances into peptone.

2. Hydrochloric acid is not the only acid which possesses this peptonising property; in the same way but in a much smaller degree, a large number of acids combined with pepsin can work this transformation from albumen to peptone; let us mention sulphuric, acetic, oxalic, tartaric, citric and lactic acids. Finally, these acids possess this property in various degrees."

Previous to these experiments by Dr. Thoyer, another eminent Frenchman, Dr. George, made similar experiments with artificial digestion and reached the following conclusions:

1. Hydrochloric acid is the one which, mixed with pepsin, is charged with peptonising albuminoid substances.

2. Lactic acid, as well as acetic and tartaric acids, are totally without digestive action.

Comparing these conclusions with those reached by Dr. Thoyer, there seem to be contradictions, but they are easily explained, as Dr. George means that these organic acids referred to, are entirely without digestive value in the stomach.

Dr. Thoyer's experiments show that these same acids combined with pepsin, may be made to dissolve albumen in glass in the laboratory, but it is to be observed that the strength of these acid solutions is so high that, in the stomach, they would act as irritants; and further, it will be shown that gastric digestion is not the only digestion to be considered. In fact, there are instances in which there is an abnormal amount of nature's own acid, hydrochloric, secreted by the stomach, and this is found to be attended by most serious disturbances of digestion and nutrition.

Gamgee, in his "Chemistry of Digestion," makes this assertion, "While pepsin is absolutely indispensable, the hydrochloric acid may be replaced by other acids, and yet perfect digestion will take place." This is not to be accepted as a true statement of all the facts. His experiments were made in the laboratory with artificially prepared gastric juice, containing an abnormal and excessive amount of acid, and the result obtained simply shows that some proteids may be dissolved by these means. It is, however, by no means proper to call this perfect or complete digestion. It is very interesting to note in these experiments, that, in the case of hydrochloric acid, as the strength of the solution was increased from four to thirty per one thousand, it lost in a direct ratio its power of digesting, so that a condition of hyper-acidity from even this

acid checks the peptone-making power, and our best observers make this margin of variation very slight. Mathieu estimates two parts per 1000 to be normal and three parts per 1000 to be excessive. Other experimenters place the acidity of the stomach at four parts per 1000. In gastric digestion it will be seen that this starch digestion must first take place to enable the gastric juice to come in contact with and to be able to do its part in digesting the albuminoid constituents of the various starchy foods.

Here attention must be called to another function of the stomach, which is of great importance in digestion, especially so in that of infants. It is the power of secreting a substance known as the milk-curdling ferment, specifically termed rennin. The power of this substance manifests itself only in its action on milk, and, in fact, it acts on no other part of the milk but the caseine. This it has the power of curdling, as it is generally expressed, but it is not the correct term to use, since it is properly a coagulating of the milk that takes place. Acids have the power of curdling, but the curd formed by rennin differs materially from that formed by acids.

FIRST.—The curd made by rennin is sweet to smell and taste, and is known as "sweet curd," and the change effected in the caseine is not a chemical one. This, when vomited or regurgitated by infants, shows a healthy state of the stomach. The curd made by acids is sour to

smell and taste, and is called "sour curd," and in this there is a chemical change in the caseine and its presence in the stomach or bowels of an infant is sure to be attended with a disordered state of digestion.

SECOND.—The curd made by rennin holds the earthy matters of the milk, particularly the phosphate of lime. The curd made by acids does not contain these substances, and the caseine thus curdled and re-dissolved cannot be coagulated by rennin, which acts freely only on neutral or alkaline mixtures. It is found, then, that acids act directly in opposition to and tend to inhibit and destroy the normal action of rennin on milk. This is a most important fact to bear in mind in connection with the use of milk as a diet for either infants or adults. Rennin does not strictly digest the caseine of the milk, that is, it does not convert it into peptone, it simply prepares it to be thus changed by the other digestive fluids. The glands secreting rennin are located mostly in the upper part of the stomach and therefore its work is done before the acid secretion of this organ takes place.

The stomach with its pepsin and hydrochloric acid and rennin has now completed its functions. These may be arranged as follows:

FIRST.—The retaining of the food mixed with the saliva while it is effecting the starch digestion. A moment's reflection and consideration will convince that this is a very important mat-

ter, for it is necessary that the starch in those foods containing it be first digested in order to lay bare and render accessible to the action of the gastric juice the albuminous parts of such foods.

SECOND.—The mixing and mingling of the food thoroughly and the neutralizing of the alkaline saliva by the stomach acid. This now gives an acid reaction to the contents, and its germicidal action is made manifest in that all organic fermentation and putrefaction are normally checked by the killing of their specific microbes by the hydrochloric acid.

THIRD.—The coagulating of the caseine of milk into "sweet curd" by the rennin.

FOURTH.—The digestion of the greater part of the albuminoid foods; that is, they are converted into a soluble and assimilable form known as peptone.

Before, however, passing to the next act in digestion, some consideration must be given to the place the stomach and gastric digestion occupy in the animal economy, because we here deal with the only acid digestive fluid in the body. It is so customary to refer all digestive disturbances to the stomach alone, that it is difficult to estimate its merely relative importance, as revealed by experiment and observation. It has been removed from animals and they have lived and thrived. Reference is made here, first,

to the experiments made by Czerny and his pupils in 1876, when he removed the stomach of a dog. The animal, after two months, ate the ordinary food of dogs, and gained in weight, so that in 1882 it did not apparently differ in any way from other dogs. This dog was killed in 1882, and a post-mortem revealed that only a small part of the cardiac end of the stomach remained. The animal had lived for six years with practically no stomach. Ogata, soon after this, established a duodenal fistula in a dog, shutting off all connection with the stomach by a rubber ball filled with water. It was now possible to introduce powdered egg and minced meat directly into the duodenum, and the result was that digestion was carried on to the extent of keeping the animal in health and with no loss of weight. In 1883, Drs. Pachon and Carvalle succeeded in extirpating the stomach of a cat. The animal was found to be as well nourished three months after the operation as before, but was less able to digest raw meat. A mixture of milk, rice, flour and yolk of egg was well digested, but milk taken alone was only imperfectly digested. Cooked meat was digested without difficulty, as was also cooked cheese and a purée of potatoes. The cat weighed four pounds when its stomach was removed and three months after, four and one-half pounds. This case proves that all three forms of food, albuminoids, fats and starch, may be di-

gested by a cat with no stomach. We come now to a still more startling proof of the non-vital importance of the stomach in man himself. In 1895 Debove and Saupault reported in "Le Bulletin de l' Académie de Médecine" their observations on a man in whom Terrier had severed the duodenum from the stomach, and reunited it again to the upper end of the organ, thus practically shutting out gastric digestion (which had been already destroyed by reason of cancer of the stomach) and permitting the food to pass directly into the duodenum. The man recovered from the operation so completely that in three months he gained in weight thirty-eight and one half pounds.

Special attention is called to these experiments to emphasize the fact that nature can virtually dispense with the only acid digestive fluid secreted by the animal economy, with apparently no loss of nutrition in certain conditions, therefore we are justified in asserting that acid is not essential to animal life. Another thought to be drawn from these experiments is that of the major importance of all those digestive processes which take place below the stomach; in fact we can assert that the digestion of all foods can be accomplished below the stomach, for many animals have no digesting power in the saliva, thus showing this not to be essential. We may then regard the stomach primarily as a receiving organ or reservoir with germicidal powers. In this

view the thing of most importance is to avoid putting into the stomach incompatible substances in the shape of food and drink, viewing these from a chemical point of view simply; and as a corollary to this, to exclude also all microbes and all microbe-breeding foods. If the mass of food to be converted into nourishment for the body is wrong in its constituents and combinations at the beginning of digestion, nature is so handicapped that the finished product, blood, is sure to be faulty, and without pure blood there can be no perfect nutrition. If the miller allows poisonous grains to be mixed with his wheat in the hopper, poisonous flour must be expected. It is to be noted here that all the essential processes of digestion are now to begin.

We have in the stomach contents more or less of albuminous food undigested by the gastric juice, and also more or less of the starch undigested by the ptyalin. The amount of these undigested substances is augmented or decreased by the proper or improper mastication of the food, the quantity taken, and the rapidity with which it is swallowed. We have all of the fats and sugars of the food still unchanged. This semi-fluid mass called chyme is now passing out of the stomach slowly, little by little, into the duodenum. There we find ready to receive it the secretion from the pancreas, called the pancreatic juice. As demonstrating the value of this organ

and its life-sustaining offices, we recall the fact that the pancreas is found in all vertebrates (perhaps with the exception of some fishes), and recent research has determined that a gland which is the physiological analogue of the pancreas is widely found in the invertebrates. It may be designated as one of the most constant of the glands. The pancreas has never been removed from any of the higher animals and life sustained for any length of time. The human pancreatic juice has never been obtained pure for the purposes of experiment. Indeed, when obtained from the lower animals it must, by depriving the animal economy of such a vital fluid, create at once marked changes in nutrition and hence modify the secretion of this very fluid itself. For the purpose of experimentation then, it is customary to use the pancreatic gland itself and attempt to extract its secretions from it. In performing such experiments it must be admitted that a slight variation in the technique in the hands of different observers may produce opposite results, more or less accidental, contradictory and confusing, therefore it would simply be useless to refer to what this or that experimenter found. In going over the literature on the subject one interesting fact is brought out, namely, that many of the earlier experimenters having found gastric digestion active only in acid media, at once assumed that acid was a necessity in all forms of digestion, and endeavored to show

that pancreatic digestion must have the same condition. This accounts for the statement made in many of the older books and copied into the newer, that the pancreatic juice can do its work only in acid media. We submit as embodying the most accurate view of this matter, the following: The pancreatic juice is invariably an alkaline fluid, its alkalinity being largely due to sodium carbonate, and its composition, as far as inorganic matters are concerned, is almost identical with the serum of the blood.

The pancreatic juice contains three digestive substances, each possessing a different power.

FIRST.—It contains a substance capable of changing starch into maltose, but in an alkaline medium only. This substance is amylopsin. Some observers say that it can convert forty thousand times its weight of starch into sugar. Now, in discussing the saliva we have shown that its normal maltose-making power is inhibited and destroyed by acid. The same is found to be true of this power of the pancreatic juice, except that, being of a more strongly alkaline nature, it requires more acid to inhibit and destroy its power than to destroy the power of the same amount of saliva. Acids, then, have no place in the normal action of the pancreatic juice in this particular, at least, but on the contrary neutralize its action by reducing its alkalinity.

SECOND.—The function of the second substance in the pancreatic juice is to digest the

albumens, both animal and vegetable, converting them into peptone as does the pepsin of the stomach, but with an activity far in excess of that of the gastric juice. This specific substance is known as trypsin. It has been isolated from the pancreas and experiments made to determine the conditions under which it acts most perfectly. These experiments must be of little value when we remember that we have not the normal alkaline medium in which nature carries on her action. Trypsin is out of its element, and what it may do in that abnormal state may be diametrically opposite to its action under normal conditions. Those experiments which imitate the latter most closely must therefore be of most value. The following experiments illustrate this point. Danilewsky found that fibrin was dissolved by the pancreatic juice only when the solution was neutral or feebly alkaline, more alkali hastening the process, a still larger quantity arresting it.

Attention must here be called to an important fact; the trypsin in passing down the small intestine will have its power gradually overcome by the alkaline mucus of the small intestine; therefore an acid condition of the contents of the small intestine is not necessary to inhibit the action of the trypsin, as some claim. Kühne, in using trypsin alone, found that its digestive power was most active, other conditions being the same, in solutions containing about one per cent of sodium carbonate. Other observers state that

trypsin may act in solutions feebly acid, but Langley shows that an extract of the pancreas, when heated with a five per thousand solution of hydrochloric acid has a decided amount of its trypsin destroyed; in the presence of pepsin all of it is destroyed. No other view of this matter, then, can be accepted except that of considering acid as inhibiting the normal albumen-digesting power of the pancreas. All experimenters admit this, for when they begin to carry on further experiments as to the influence of trypsin, they use simply the one per cent solution of sodium carbonate as their medium.

THIRD.—We come now to the third digesting substance in the pancreas, that having the power to split up and emulsify the fats, thus rendering them capable of assimilation. The name of this is steapsin. As most fats contain acids in their composition, and as acids have no action whatever on fats, it is necessary to consider only the alkaline reaction of the pancreatic juice in its action on fatty matters. Some observers, nevertheless, have tested the power of the pancreas in digesting the neutral fats in the presence of free acid and found that in these conditions, its power was destroyed.

All digestion of fats, then, is conceded to be possible only when the pancreatic juice is acting in alkaline media.

So far, then, but one conclusion can be drawn from what has been said. We have treated the

pancreatic juice as a whole, and have tested each of its three active principles, and their normal action in all cases is found to be inhibited, interfered with, or destroyed by the presence of acid.

One fact must be referred to here as bearing on what has been said concerning bacteria. It is found that the digestion of proteids by trypsin associated with bacterial action, is attended by the evolution of large quantities of inflammable and fetid gases. When, however, bacteria are excluded, the digestion of the proteids proceeds without the evolution of these gases and there is, on the contrary, an absorption of oxygen from the surrounding medium, from which we are justified in inferring that bacteria are detrimental to pancreatic digestion.

We come now to consider a fluid which in man, and in many animals, we find entering the digestive tract through the same opening as does the pancreatic juice and thus mixing with it, as it enters the duodenum. We refer to the bile. Its very mingling with the pancreatic juice leads one to think that its office in digestion must be that of an aid to the pancreatic juice, and research has confirmed this view.

Biliary fistula has been produced in animals as well as in human beings, by which means the entire amount of this fluid has been withheld from entering the alimentary tract during diges-

tion, and the following facts have been well determined:

FIRST.—That it is an alkaline fluid.

SECOND.—That the digestion of starchy and proteid constituents of food proceeds normally in animals and human beings with biliary fistula, thereby showing that it is of no assistance in the digestion of these substances. Now if a portion of partially digested matter be taken from the stomach and a quantity of bile be added thereto, the action of the pepsin is at once destroyed. The wisdom of this is readily seen when we recall what has just been stated; namely, that the trypsin of the pancreatic juice is destroyed by pepsin. The bile, then, may be said to prepare the undigested matter from the stomach for the action of the pancreatic juice.

The action of bile upon fat remains to be considered and it is found that it has the power of uniting with the fatty acids and emulsifying the neutral fats, which probably the pancreatic juice alone cannot act upon so readily. This power is not due to any specific principle, as is the case in the other glands, but is simply chemical in its nature. It is, however, of vital importance in digestion, because in experiments made upon dogs without biliary fistula only one per cent of a given amount of fat fed to the dogs was found in the fæces, while of the same amount of fat given to dogs with biliary fistula, as much as

sixty-six per cent of the whole amount swallowed was thrown off in the fæces.

In a late and interesting article by Prof. Rachford, M. D., of the Medical College of Ohio, Cincinnati, O., on the "Comparative Anatomy of the Bile and Pancreatic Ducts in Mammals, Studied from the Physiologic Standpoint of Fat-Digestion," he demonstrates, by means of a set of comparative measurements made on many different animals, that the openings provided for the passing of the bile and pancreatic juice into the intestines are definitely arranged with regard to the amount of fat which enters into the food of the animal, showing the bile to be intended primarily for mixing with the pancreatic juice for the emulsification of fat. Prof. Rachford has deduced the following conclusions:

1. "Pancreatic juice splits fats into fatty acids and glycerine.

2. "Fat splitting is a necessary preliminary step in fat-digestion.

3. "Bile has no independent action in splitting fats.

4. "Bile expedites the fat-splitting properties of pancreatic juice in the ratio of 3 to 1."

The bile and pancreatic juice may therefore be considered as a single digestive fluid, and, as each is alkaline, acid inhibits their action, whether the action is considered as manifested singly or by both in combination.

The bactericidal powers of the bile itself are established beyond doubt, for it is well known that it checks fermentation. The liver, moreover, has an anti-toxic action, which Dr. Schupfer, of the University of Rome, proved that it manifests in lessening and neutralizing the power of certain poisonous alkaloids, not only those introduced into the blood from without, but those elaborated within the body as well. That is, its power is the same on either ptomaines or leucomaines and the following micro-organisms have been found to be eliminated from the system through the bile: The bacillus of glanders, the bacillus of typhoid fever, the spirillum of cholera, the bacterium coli commune, the bacillus of anthrax, the staphylococcus pyogenes aureus, the bacillus pyocyaneus, Friedlander's pneumococcus, and others.

The liver may then be said to disinfect and purify the blood as it passes through it; hence, when the contents of the stomach and digestive tract are subjected to fermentation, resulting from the presence of bacteria and the attendant production of the ptomaines beyond a limit which the liver can normally neutralize, we have a systemic poisoning, with all the well known symptoms classed under the head of biliousness. The wisdom of adopting a dietary free from the ptomaine-making microbes becomes at once evident, because, let it be remembered, microbes in certain conditions have the power of deranging the action of and even destroying living cells. It

must not be thought that their power of resolving organic matter into its elements is necessarily confined to dead matter.

We have said that bile contains no specific food-digesting substance, but we find that the liver itself has the power of converting certain products of digestion into a substance known as glycogen, which is then taken up and carried by the blood to the various structures of the body, where it is consumed in the generation of force or heat. A definite amount of glycogen must always be in the liver, but if an excessive amount of food rich in this substance be given, sugar for instance, it appears at once in the urine, the liver, as it were, being overwhelmed with work, thus setting up an abnormal condition which must be corrected. It is to be noted that this fact is another instance of the intolerance of nature of any attempt to change the normal balance of food composition, to which attention was called in Chapter I.

The liver, then, may be regarded as a storehouse holding the excess of the digested forms of starch from the blood in the shape of glycogen, which it serves out for nutrition little by little, as the animal economy may require it. The bile, we have thus determined, has the office of making available and increasing the digestive power of the pancreas in its action on fats. As this is effected chemically by its alkaline reaction on the fatty acids, it naturally follows

that in the presence of acids its functions must be entirely lost. The bile is also an antiseptic and ferment destroyer, and probably acts as a laxative, and, by reason of the poison-neutralizing power of the liver, must be regarded as partly an excretion.

The chyme, now, while being acted upon by these latter secretions, is in the duodenum or upper part of the small intestine and is slowly being propelled downward. We may find in it here some remaining albuminoids, starches and fats upon which the digestive action has not ceased, but it consists principally of peptone, maltose and other sugars, and emulsified fats, the whole now being normally a homogeneous semi-fluid mass, which should be free from fermentive and putrefactive odors, and alkaline in reaction.

We may here properly consider the small intestine as a single digestive organ, without any reference to the arbitrary division into duodenum, jejunum and ileum, and we shall endeavor to determine, as far as is practicable, in what condition that organ normally performs its digestive functions. Anatomically we have to deal with a multitude of small glands, secreting an intestinal juice having a specific power, but differing no doubt, in degree in various parts of the small intestine. This makes the study of this part of digestion somewhat perplexing, but we shall treat the intestinal juice as a single secretion. It has been

obtained for observation and experimentation, and shows the following properties: It is a pale yellow liquid of a powerfully alkaline reaction, containing, as it does, an average of one half per cent of sodium carbonate. Acid, as will at once be seen, must neutralize its action, but being so strongly alkaline and being constantly secreted, it is possible for it to neutralize a very decided amount of acid and still retain its alkaline reaction. Its office, then, is to neutralize those acids which having escaped the action of the pancreas and bile, have by their presence checked the digesting power of the trypsin, which is thus enabled to resume and complete its action.

The intestinal juice has been tested for its action upon starch, albuminoids, and fats, and the results show that it has in itself no action on them. Upon the maltose, however, which was made from the starch by the saliva and pancreatic juice, and also upon all other forms of sugar which may have been taken with the food, the intestinal juice manifests its specific action in digestion. This consists in converting all these different forms of sugar into a less complex and more absorbable substance known as glucose or invert sugar. This transformation, experiments have proven, can be only effected in neutral or alkaline media. Acids invariably inhibit and destroy this action.

Further experiments reveal another very important function possessed by the small intestine,

that of the final transfer of the digested matter in them to the blood. This power resides apparently in the epithelial cell, and it is enabled by it to transform peptone into serum albumen or globulin, in which form alone it can enter the blood. This can only be effected in an alkaline medium, and here is seen the use of the strongly alkaline intestinal mucus, and we can readily understand how acid causes derangements in nutrition, the effect of which is manifold, and affects every structure of the body.

This peptone-converting power has been demonstrated by placing a piece of small intestine, well cleansed, in a solution containing peptone, (which, be it remembered, must be alkaline in reaction to effect the change), and noting that, after a sufficient time has elapsed, the most delicate tests fail to detect any peptone, demonstrating that it has been resolved into another form. That such a change was made somewhere in the digestive tract was self evident, for peptone is never found in the blood. In fact, if peptone is injected into the blood, strange to say, nature treats it as a poison and eliminates it at once by way of the kidneys.

We sum up, then, the part taken by the small intestine in digestion as follows. Its office is

FIRST.—To neutralize any excessive acid in the downward passing chyme and thus permit a continued action of the pancreatic juice and bile.

SECOND.—To convert cane sugar and maltose into invert sugar, ready for absorption, effecting this normally only in neutral or alkaline media.

THIRD.—To change peptone into serum albumen, which is thus enabled to reach the blood. This, of course, is effected only under the alkaline reaction, for serum albumen is soluble only in alkaline solutions. It is to be noted here that the emulsified fats pass into the blood without further change, through the lacteals.

We have now traced the digestion of the starchy, albuminous and fatty forms of food, and sugar also, from the time of entering the mouth until they are made ready to pass into the blood, the great nourishing fluid of the body. We have considered the conditions most favorable for the action of all the digestive principles, viz.: the ptyalin, the pepsin, the rennin, the bile, the trypsin, the amylopsin, the steapsin and the intestinal juice, and *all the processes, we find, with but one exception, are normally effected in alkaline media.* The one exception, the gastric juice, acts only while the food is in the stomach, and experiments have been cited to show that even here acid is not essential to life, but, on the contrary, that the acidity of the stomach contents should be at once neutralized as soon as they leave this organ for the normal completion of digestion. We have found that no other acid can take the place of hydrochloric acid in digestion, but that

this and all other acids inhibit and destroy the activity of all the other digestive principles. *We are thus justified in asserting that free acid has no place in true food; it contributes in no way to nutrition; it affords no aid to digestion; but on the contrary it embarrasses, retards and inhibits the normal action of digestion, and thus most seriously lessens both nutrition and vitality.*

As directly connected with this topic, reference is again made to the difference of opinion among observers as to the alkaline or acid reaction of the contents of the small intestine. In investigating this matter there is to be taken into account the great difficulty of being sure that we are dealing with a strictly normal condition of the intestinal contents, and hence it is prudent to look at this matter from the standpoint of what we know to be true, and seek its confirmation by what we find. Turning to our knowledge of therapeutics, we observe these facts:

FIRST.—Alkalies increase the acid condition of the stomach. We have shown, however, that an alkaline condition of the stomach contents inhibits gastric digestion; it is then an abnormal condition of things to be overcome, so nature pours out the hydrochloric acid until the alkali is neutralized and the gastric juice has recovered its normal acidity and activity.

SECOND.—Alkalies decrease all alkaline digestive secretions. This is natural, for nature is

conservative, and will not waste alkaline secretions on media already alkaline.

THIRD.—Acids increase all alkaline secretions; viz., the saliva, the pancreatic juice, the bile and the intestinal juice and, as we have shown that acids destroy the normal action of these fluids, nature must neutralize the acid before normal digestion can be resumed, and we have therefore, to this end a forced secretion of these alkaline fluids, and a direct loss to the economy of just that amount of saline matter.

FOURTH.—Acids decrease, as naturally follows, the acid secretion of the stomach, another illustration of nature's conservatism.

Taking then, these facts in connection with what has already been proved, viz., that acid interferes with and arrests the normal digestive process of the alkaline digestive fluids of the body, we cannot escape the deduction that the contents of the small intestine must be normally alkaline. Certainly it must be so at all points below the duodenum, say ten or twelve inches below the stomach, for here the neutralizing action is most actively in progress. That the intestinal contents are invariably acid is claimed by Gamgee in his last work on the "Chemistry of Digestion"; he quotes to sustain this view the observations of Macfayden, Nencki, and Seiber, made in 1891, on a woman who had a fistula in the ileum. No doubt the contents of her small intestine in these conditions were acid. We should expect to find it

so, and for this obvious reason. The fistulous opening afforded a very ready means of entrance into the small intestine for all the various fermentive and putrefactive microbes, which would themselves cause this acidity, and which we have shown have no place there, except for harm. So, too, the taking into the digestive tract of more free acid than the alkaline digestive secretions can neutralize, will result in an acid condition of the intestinal contents, but it is nevertheless an abnormal condition and, as we shall be able to show in another chapter, is attended with derangements of health of more or less severity, according to the length of time that this condition has existed. Nature, to utilize the products of digestion, requires the presence of alkali, and it must be in excess at the time of assimilation, therefore, it is that the normal reaction of the contents of the small intestine is alkaline. It is to be considered in a nutrition-disturbing, disease-inviting condition, just as soon as the acid in it cannot be neutralized readily and wholly by the intestinal juice. Nature is probably able to take care of such acid as may be liberated in what may be called our natural food, but there is a constant tendency to use food containing an excess of acid or acid-making microbes, and the wisdom of avoiding such is now apparent.

Attention is here called to a unique and most convincing proof of the normal alkalinity of the contents of the small intestine, in the salol test,

devised by Ewald, for the determining of stomach mobility. Salol, as is well known, is split into salicylic acid and phenol only in an alkaline medium; the change can never take place in the presence of acid, and that the decomposition has taken place is at once made clear by the presence of salicyluric acid in the urine. A given amount of salol being swallowed in a capsule, the stomach being acid, no chemical decomposition of the substance can be effected in that organ; hence it reaches the small intestine intact, and the question of its being here decomposed or remaining unchanged, simply tells us as to the alkaline or acid condition of the small intestine. Now, selecting cases in which all conditions are as near normal as possible, on making a series of observations it is found that, in the great majority of tests the salicyluric acid appears in the urine, showing the intestinal contents to have been alkaline. The writer has had the opportunity of making several direct tests and observations on the contents of the small intestine, under conditions as nearly normal as could be expected, and he found just what might be looked for in accordance with what we know of this subject, viz., an alkaline reaction of the small intestine contents.

It is well here to note the difference of opinion which obtains among observers as to the acid or alkaline reaction of the contents of the large intestine. Nearly all observers assert that the fæces are normally acid, and this too, in face of

the fact that the mucus and other secretions of the large intestine are admitted to be strongly alkaline. These differences of opinion we can see at once must arise from the normal or abnormal condition of the contents of the small intestine above, or the presence in the large intestine of too many fermentive and putrefactive microbes.

Repeated observations have demonstrated that normally the fæces are alkaline in reaction, and this fact constitutes confirmatory proof that there must be naturally an alkaline reaction in the whole intestinal tube, for it is evident that the state of the secretions both of the small intestine and the colon must be the same, and that alkaline, for only under the alkaline reaction can digestion be normally effected by the pancreatic juice, the bile, and the intestinal juice. This fact may thus be concisely stated—*free acid has no place in intestinal digestion.*

CHAPTER III.

THE EFFECTS OF DIFFERENT KINDS OF FOOD ON THE BLOOD.

In view of the fact that so much acid is taken with food, in the form of acid fruits, pickles, and sour salads, and drunk in the form of lemonade, and various other acid drinks, such as hock, claret, and sour wines, it seems best at this stage of the discussion to consider the effect of acids on the blood. The subject is one of the greatest importance, because in addition to the free acid which is swallowed, there are various acids formed in the digestive tract by micro-organisms, which are more inimical and harmful in their effects than the free acid which is swallowed, for the following reasons:

FIRST.—Because they are so likely to be overlooked as a cause of disease.

SECOND.—Those acids which are developed in the alimentary tract, as the result of the action of microbes, possess a nascent activity quite in excess of that shown in laboratory experiments. The rapid action of lactic acid, generated by its microbe, on the teeth, causing decay, to which attention has already been called, is a case in point.

THIRD.—The acid-forming process of fermentation is a continuous one, hence it is constantly exerting its deleterious effects. A free acid may be swallowed and neutralized, and there the action ends. In the case of the other acids their action can only be overcome when the cause of their formation is removed.

In taking up this topic we naturally begin with the consideration of the blood, regarding it as the great organ of nutrition, it being the carrier and distributor throughout the body of all the nutriment derived from food, while on the other hand, the results of tissue waste are taken up and carried by it to the proper excreting organs for removal from the animal economy. It also carries, equally well, all poisons and the germs of all diseases which may interfere with or imperil life. More than this, so definite and fixed is the composition of normal blood, that slight changes in its chemical quality are attended with more or less serious disturbance of the functions of life. A variation in the quantity of even normal blood in the system, be it too much or too little, constitutes a disordered condition. The liquid element of blood is an alkaline fluid, and its alkalinity is due to the presence of disodic phosphate and the carbonate and the bi-carbonate of sodium. This is known as the blood plasma, and its chemical constituents are, according to Hoppe-Seyler, Schmidt and others,

Common salt..................	5-92 per thousand.
Sodium sulphate....	0-24 per thousand.
Sodium carbonate	1-21 per thousand.
Sodium phosphate..............	0-27 per thousand.
Calcium phosphate	0-29 per thousand.
Magnesium phosphate..........	0-21 per thousand.

combined with 90 per cent of water and 10 per cent of organic matter. In this alkaline fluid are three forms of active protoplasm, known as the red corpuscles, the white corpuscles, and the blood plates. These are the true vitalizing, life-sustaining elements, and on their ability to properly perform their functions depends the condition as to health, disease or death of the animal.

The function of the red corpuscles is that of a carrier of oxygen to the several tissues of the body, by means of which the glycogen and fats are oxidized and heat and force are made manifest. The work of the red corpuscles is performed while they are inside of the blood vessels. These are to them, in fact, simply a system of tunnels through which they carry on their work of transportation.

The white corpuscles are not thus limited in their movements.

They possess a power of their own in being able to leave the blood vessels and to invade any tissue and all parts of the body (diapedesis). The walls of the blood vessels form no barrier to the white corpuscles, for they can, by an inherent, vital power of their own, contract and elongate

themselves so that they can squeeze through the intercellular spaces in the walls of the blood vessels and thus penetrate the connective tissue beyond. Following in their wake, the blood plasma leaks through the openings the corpuscles have traversed, thus furnishing them with their liquid element, in which and with which to do their life work, in whatever part of the body they may be summoned to. We say summoned, for such is literally the case. It is found that where there is irritation, or injury, or infection of the living tissues of the body, there the white corpuscles gather like a defending army, and following after them comes the blood plasma, which may be likened to the supply train of necessary material, thus enabling the white corpuscles to rout the noxious invader, and to repair the damage which may have been done. The classical experiments of Metschnikoff show that the white corpuscles have the power of taking into their very substance and literally digesting foreign bodies appearing in the blood, particularly noxious bacteria (phagocytosis).

These are all the functions of the white corpuscles and attending blood plasma that will enter into our discussion. They may be summarized as the life-defending and life-saving functions. It must be apparent that anything which changes or interferes with the normal condition or composition of the blood plasma must affect the whole of nature's operations, as the

blood plasma is the material in which and with which, the white as well as the red corpuscles do their work. The function of the blood plates we shall not venture to consider in the present stage of our knowledge, but we are justified in holding that they must be influenced by the same chemical agents that affect the red and white corpuscles. These being themselves masses of living protoplasm, they must require a proper medium in which to exercise their functions, and hence we see the importance of maintaining the normal alkalinity of the blood. Besides being the normal liquid for the life action of the corpuscles, the blood plasma is found to have a germicidal power, which plays a very important part in explaining the immunity from disease which we find frequently manifested by man and which experiments show to be possessed also, in different degrees, by various animals.

Nuttall of Göttingen, in 1890, proved by experiments on different animals that the germicidal power of the blood resided in the serum and was independent of the cellular element, and he concluded that this active element is a living albumen, depending upon an alkaline base for its composition.

We may say of animals and with equal truth of man, that the individual predisposition to contract an infectious disease has a direct relation to the germicidal power of the serum of

the blood. Let us then endeavor to ascertain what increases or maintains this germicidal power, and what substances tend to decrease and neutralize it. The work of all observers and experimenters in this field has led to unanimity of opinion. Their deductions as summed up by Dr. Josef von Foder and published in February, 1895, cover all the points desired to be made here. He made a large number of observations by injecting into the blood of living rabbits the bacilli of anthrax, cholera, typhoid fever, tuberculosis and erysipelas, and the results uniformly showed that in the living organisms there is a definite connection between the pathological action of certain bacteria and the alkalinity of the blood. Furthermore, if the alkalinity of the blood is increased after the introduction into it of these bacilli, the germicidal power is increased, and this increased alkalinity can be affected by administering, through the mouth, sodium carbonate, and also the other normal salts of the blood, viz., sodium phosphate and potassium phosphate. That increasing the alkalinity of the blood is nature's process for overcoming certain bacteria, is shown by the fact that after infecting the blood with them there is a sudden increase in its normal alkalinity, nature apparently abstracting from the tissues themselves alkaline salts for this purpose. If the infection is fatal the alkalinity becomes progressively less and less. If the case is not fatal the decrease in alkalinity

is correspondingly slight, and is followed by an increase in alkalinity above the normal, or at least above that existing before infection. These facts make it plain that acids, neutralizing as they do the alkalinity of the blood, must lessen this power, and experiments have shown that the organic acids have a most marked action in this direction.

Another vital power possessed by the blood, the inhibiting of which is attended by more or less serious complications, is its power of coagulation, and the extent to which the action of acids on the blood lessens this power belongs properly to our topic. Fortunately, we have some very late experiments made by Dr. A. E. Wright of England on this very point and we quote from his own report of experiments made on himself as follows: "At 1:45 p.m., 4½ hours after a light breakfast, coagulation time 5 min. 4:15 p. m., 3¼ hours after a light luncheon, coagulation time 3 min. 10 sec. 4:30 p.m., 6 grams of citric acid swallowed in 50 C. C. of water. 6:40 p.m., coagulation time 7 min. 15 sec. 9:45 p. m., 2 hours after dinner, coagulation time less than 3 min. 40 sec. One week later: 2:30 p.m., one hour after a very light lunch, coagulation time 5 min. 40 sec. 2:50 p.m., swallowed 5 grams of citric acid in 100 C. C. of water; 4:50 p.m., coagulation time 6 min. 50 sec. 5:30 p. m., coagulation time 7 min. 50 sec. 7 p. m., coagulation time 7 min. 40 sec. 9:15 p.m., 1¾

hours after dinner, coagulation time 7 min. 50 sec.

The results shown appear to be conclusive with regard to the only question really at issue, that is, whether citric acid can be absorbed from the stomach in sufficient quantities and with sufficient rapidity to exert influence on coagulation. The administration of vegetable juices such as lime juice, which contains citric and other organic acids (circ 8 per cent.) with a certain small admixture (circ 0.3 per cent.) of the soluble salts of these acids, constitutes the routine treatment for scurvy. It is impossible, however, to avoid a belief that this administration of citric acid must be prejudicial in any disorder in which there is a tendency to hemorrhage. I have, through the kindness of Captain Surgeon Whitehead, had a recent opportunity of actually observing the unfavorable influence exerted on incessant oozing hemorrhage from the gums by the daily exhibition of the juice of three lemons in the form of cooling drinks. The disadvantage of lemon juice in these cases will be apparent to any one who will test the effect of the addition of a minimal quantity of lemon juice to a little blood in a capillary tube provided with a mixing chamber. Further, if, as seems assured, scurvy is a condition in which the normal alkalinity of the system has been dangerously diminished, the administration of free citric acid, quite apart from its influence in diminishing the blood coagulability, is quite use-

less for all purposes of treatment, and it is evident that its place ought to be taken by the neutral citrates and tartrates or preferably acetates, which would supply the alkaline bases which are required by the blood.

The eating of unripe fruit which contains free vegetable acid is known to be a frequent cause of certain urticarious œdemas. These œdemas and the frequent epistaxes also, if we may judge from my own case and from a few others which I have seen incidentally, are most prone to occur during the period when ossification is proceeding most rapidly, and when lime salts in large quantities are being withdrawn from the blood. It would evidently be interesting in view of these considerations to have the conditions of blood coagulability tested in these cases."

From these very interesting observations of Dr. Wright we are led, as bearing most naturally on the general subject, to consider further the treatment of scurvy. This condition illustrates in the most forcible manner what takes place when the blood has been robbed to the last extent of its alkaline salts.

We find the victims of this disease emaciated, overcome with weakness and prostration, and rendered breathless by the slightest exertion. The blood, having lost its power of coagulation, oozes from the gums and mucous membranes; racking pains in the legs and joints torment the victims, and so closely do the symptoms resemble

rheumatism in their character, that mistaken diagnoses are frequent. We find that the Esquimos live almost entirely, year in and year out, on fresh meat, and are free from scurvy, as are likewise those people of India and China whose diet consists of fresh vegetables with an entire absence of meat.

Scurvy, then, is caused by the deprivation for a sufficient period of time of either fresh vegetables or fresh meat as an element of food. It is simply necessary that the food withheld, without regard to kind, be fresh, using this word in contra-distinction to dried, preserved, condensed, artificial, or salted. This is another confirmation of the law referred to in Chapter I., that food, to serve nature's purpose, must contain its constituent elements in the combinations and forms made by nature, and any attempt to interfere with them modifies more or less harmfully its value as food.

An early act of the English parliament required ships on long voyages to carry lime juice, which was served out to the sailors for the purpose of preventing scurvy. We see at once why it was beneficial in these cases, because it provided, in spite of the acid it contained and which has been shown to be harmful, a supply of the alkaline salts in a natural and fresh form as required by nature for the blood. Other forms of vegetable food are found, however, to be better adapted for preventing scurvy, and especially

onions, cabbage and potatoes; showing that acids alone, as we have already seen, take no part in increasing the alkalinity of the blood. The general belief that the eating of sour fruits is necessary in order to prevent scurvy is an erroneous one. Fresh vegetables or fresh meat is all that is required, and the less free acid in any form the better the alkalinity of the blood is maintained. Lime juice is used for an anti-scorbutic as an expedient, because it has the property of retaining for a long time its natural state of freshness. Of late years it has been found that cabbage put up as sauer kraut is a valuable anti-scorbutic, and is readily accepted by nature as a fresh vegetable food. At the present time it is largely used as such on ship board.

Let us now refer to the very interesting observations and experiments made by Dr. Franz Hofmeister "On the Action of Acids on Animal Organisms," published in the "Prager Medicinische Wochenschrift," February, 1879. No English translation of this very instructive article has appeared, so far as is known, therefore, we quote from it.

"As the blood and most of the fluids of the body contain prominently reacting alkaline salts, viz., carbonates and phosphates, the introducing of acid will consequently withdraw from these salts part of their bases. The rich alkaline combinations are therefore transformed into acid combinations, or at least into poorer

alkaline ones, thus reducing the alkalescence of the bodily fluids. The next effect of acids will be, therefore, the neutralization of the alkaline salts. The new formed salt, which, compared with the normal condition of the salt, is a surplus, has to submit to the same destiny to which all superfluous salts are subjected, viz.: it will, in more or less time, be excreted through the urine; thus the neutralized alkali formation leads to the excretion of alkali. The action of acids is, however, much influenced by the peculiar regulating activity exercised by the alkaline reaction of salts present in the blood and tissues. These, owing to their composition, are in a condition to receive as well acids as bases, and in this way, through their interference, to hinder the presence of free acids or bases. To this we must add that the organism, through its ability, according to necessity, to eliminate through the urine acid or alkaline salts, and through its power to increase or diminish the amount of carbon dioxide given off by the lungs, possesses two means by which within wide limits can be brought about the normal relations between acid and base.

In the experiments which have been made for the determination of the questions in dispute, dogs and rabbits have generally been used and two different methods of experimenting have been employed by different experimenters. Walter started with the presumption that blood contains carbon dioxide exclusively, or almost so, in a

form of combination. The quantity of the combined carbon dioxide depends, however, on the quantity of the alkaline salts present in the blood which can enter into combination with it. A diminution of these salts causes a reduced capacity for absorbing carbon dioxide and, therefore, conversely from the lessening of the capacity to take up carbon dioxide, a diminution of the quantity of alkaline salts in the blood. Other observers directed their attention to the secondary alkali excretion, in order to determine in what quantity and form the introduced acids would be excreted, and they estimated the proportion of acids and bases in the excreta before and after the feeding of acids. These results were attained in a thorough and reliable manner by a quantitative estimation of the bases and acids excreted through the urine. The results reached by each investigator by the above named methods agreed in so far as proving that the introduced acid produces a reduction of the alkaline reacting salts of the blood, which are therefore, eliminated through the urine, by which the organism loses therefore, more or less of the alkaline contents of the blood.

A considerable difference in the result produced depended upon the species of animal selected for the experiments. If to a rabbit in the course of a day is given so much hydrochloric acid that the quantity surpasses 0.9 grammes HCL. per kilogram of weight, there will soon be violent symptoms of poisoning, and death will result in

a few hours. The symptoms of poisoning to which we wish to call special attention, are increase of the respiration, beating of the sides and a gradual loss of the ability to move; the breathing becomes more superficial; finally a complete collapse occurs, with cessation of the breath, and shortly after of the pulsations of the heart. The blood of the animal selected for the experiment does not lose completely its alkaline reaction during its life, but the same is considerably weakened. The power of the blood to combine with carbon dioxide experiences hereby a significant reduction. The carbon dioxide contents of the blood which formerly formed over 20 vol. per cent, diminish rapidly during the administration of acid and amount shortly before death only to 2 to 3 vols. per cent. The urine during the time of experimentation contains the largest amount of the administered acids in the form of salts.

The results of the experiments with the dog are entirely different. The dog does not to all appearances suffer in the slightest, although he be given a quantity of acid three times surpassing the 0.9 grammes per kilo. of weight which is a deadly dose for the rabbit. The reduction of the alkalescence of the blood as well as the diminution of the amount of carbon dioxide is within much smaller limits than in the case of the rabbit. In the urine appears a relatively larger quantity of acid corresponding to the quantity of acid administered. This is, however, not the case with the

fixed bases, as their quantity is not sufficient for the saturation of the acids present, but considering the changes caused through the administration of acids, we are struck with the very large reduction of the amount of the alkaline reacting salts of the blood. This reduction is clearly demonstrated by the weakening of its alkaline reaction, and in the diminution of its capacity for combining with carbon dioxide.

This is closely concerned with the causative connection of the deadly result and must be considered as proven should we succeed, through the administration of an alkaline reacting salt, in annulling the effects of the acid action. This proof was indeed obtained by Walter, who restored to perfect health rabbits that had been brought to the point of death by the administration of acids, and were restored, as before said, by means of carbonate of sodium injected into the jugular vein. These results were obtained even in cases where respiration had already ceased, and the restoration was permanent: if not, as exceptionally happened, it was in consequence of an extensive formation of thrombus caused by the intravenous injection. The presence of a certain quantity of alkaline reacting salts (carbonates and phosphates), is therefore a necessity of life.

This can be demonstrated in the following manner. The aforesaid salts take up the carbon dioxide formed in the tissues under normal circumstances, and give it off upon reaching the lungs

to the pulmonic air. If their quantity falls under a certain limit, the carbon dioxide formed in the tissues does not find enough salts in combination with which it can reach the lungs, consequently its amount increases in the place of its original formation, and it impedes the functions of the organs. This pernicious influence shows itself first in that part most sensitive to carbon dioxide, viz.: in the nerve centers of respiration. From this point of view results the apparently paradoxical conclusion that an animal whose blood contains one-tenth as much carbon dioxide as it normally does, can yet find its death through carbon dioxide poisoning. Paul Bert has shown that it depends not upon the absolute quantity of carbon dioxide which is in the blood, but upon the relative proportion between carbon dioxide and the salts with which it can combine: only the superfluity of carbon dioxide acts poisonously. The deadly action of acids administered to rabbits is, therefore, explained. The animal is suffocated by the self-produced carbon dioxide, not being able, by reason of the diminution of the alkaline reacting salts of the blood, to eliminate it.

The tolerance of the dog to acids, upon investigation, is found to be due to the fact that in the organism of this animal, acids unite not only with fixed bases but with a volatile one, viz.: ammonia, and to such an extent, indeed, with this that even three-fourths of the acid administered can be eliminated from its body in the

form of ammonia salts, and at the same time the dog is thus able to save an equivalent of the blood alkali, which in the rabbit or any other animal not having this ammonia-secreting power would be entirely lost with the result as noted. To what degree a long continued administration of acids may produce a change in the organism of man we have no proof, yet we are tempted to ask whether the reduction of the alkaline salts of the blood caused by the administration of acids, thereby lessening the gas exchange (elimination of carbon dioxide,) should not be considered as a pathological change. We must furthermore remember that in sickness the reduction of the saline constituents of the blood, and the impediment to the elimination of carbon dioxide are often combined."

The first thought to which the author wishes to call attention, after reading this very interesting report of Dr. Hofmeister, is the fact that while the dog is very tolerant to acids because of his ammonia making power, the effect produced on man by the administration of acids would be more nearly like that produced on the rabbit, since the organism of man has not the ammonia making power of the dog.

The reference made by Dr. Hofmeister, to the necessity of a definite amount of alkaline salts in the blood to prevent poisoning by carbon dioxide, is so important and interesting that we recall the now generally accepted views of the

chemical action which really takes place. About three-fifths only of the carbon dioxide eliminated from the body can be held in solution in the blood, two-fifths then must be accounted for and disposed of in some other manner. Carbon dioxide is an acid gas and enters into chemical combination with certain bases in the same manner as any of the sour acids, but the union is more easily broken and does not necessarily require the presence of a stronger acid to effect it. This is particularly true of the union of carbon dioxide with sodium, for it is known that if the bicarbonate of sodium be placed in a vacuum or partial vacuum, a part of the carbon dioxide is given off and the salt is reduced to the condition of a carbonate. This is precisely what happens in the body, the lungs doing what the air pump does in reducing pressure. The carbon dioxide being set free in the tissues by the oxidation of the proteids, the glucose and the fat is taken up by the carbonates of the various alkalies in the blood, which are thus changed into the bicarbonates, and being conveyed to the lungs, where the atmospheric pressure is lessened, a part of the carbon dioxide is liberated from the salts and eliminated. The alkalies remaining in the blood in the condition of carbonates are carried back by the ultimate capillaries to the tissues and the process repeated. If nature, then, is called upon to use any of these alkaline salts for the neutralizing of free acid, it must be at the expense of

the alkalinity of the blood, and therefore the normal carbon-dioxide-eliminating agent is lost in just that proportion, and in just that degree damage is done. As strongly confirming this view may be noted the fact that if vegetable acids be taken by nursing mothers, their milk becomes charged with carbon dioxide and therefore gripes and purges the infant.

The statement of Dr. Hofmeister that there is no proof of what may be the effects of long-continued administration of acids to man, leads the writer to report some observations and tests which he was so fortunate as to have the opportunity of making, as to the effects on man of a diet consisting almost exclusively of the acid fruits. The case was that of a perfectly healthy man who had charge of the fresh fruit department of a large store. He was, moreover, a firm believer in the nourishing and health-giving powers of fresh fruit as a diet. The fruit which he ate was such as is offered on the markets and which, as a whole, can properly be classed as super-acid, because most, if not all of it, is gathered long before it is ripe, and hence abounds in free acid. The fruits of which he made use, beginning in the spring, as they came upon the market, embraced the grape fruit, lemons, oranges, strawberries (the Wilson variety, which is intensely acid), apples, cherries, plums, peaches and pears. It was his duty to sample and test the different invoices of fruit;

hence he was confined to no single variety. His diet consisted almost entirely of these, supplemented occasionally with crackers and cheese. When he began his work he was a perfectly healthy man, weighing one hundred and sixty-five pounds. He followed this diet as closely as possible for three months, during which no intercurrent disease, such as any marked indigestion or diarrhœa occurred, to account for the loss of flesh and a general feeling of lack of normal health, which was gradually taking place all this time. At the end of twelve weeks he found himself with a loss of twenty-five pounds of flesh, a general loss of strength and a hacking cough, and with a cachexia so marked that his friends said he was going into consumption. A test of his blood showed it to be deficient in alkalinity, his urine was hyper-acid and his saliva had lost its alkalinity. That all these derangements of nutrition from which he was suffering were due to his ingesting too much acid was made apparent, for by the simple administration of alkalies and the withdrawal of the acid fruits from his diet, he was soon restored to his normal robust health, but with new ideas as to the nourishing properties and health-sustaining power of fruits as offered on our markets.

The results obtained in this case are confirmed by the experience of those working in vineyards who try to live on grapes only. It is found that under this diet they lose weight and strength

rapidly, and they are forced to take other food to maintain their health. Yet the grape ranks among the most nourishing of the sub-acid fruits. Since making the observations on this case, the writer has come across an article by Cantain on this very subject of the action of acids on the animal economy, in which he reaches the same conclusions. He dissents from the common view that the fruit acids promote alkalinity of the urine permanently, proving that this is true only of the ingestion of small quantities, but that larger amounts or the continued administration of these acids, make the urine strongly acid.

The carbon dioxide poisoning which takes place as the result of a reduction in the alkalinity of the blood, causing paralysis of the respiratory centers, deserves careful consideration, as it may throw light on some pathological conditions and the proper means of aiding nature in overcoming them; therefore, we emphasize here the importance of testing in all cases of disease if not the blood itself, at least all the excretions and secretions of the body, as a means of determining at once whether the blood is being reduced in alkalinity or not. In fact, on this point turns the vital decision whether the patient should receive acid or alkali in food, drink or medicine.

The writer has made a great number of observations and tests of the excretions and secretions of the body, in health as well as in all forms of

disease, with reference to the normal or abnormal elimination of salts from the blood, and has uniformly found it a point of great value in the treatment of disease. Repeatedly has he demonstrated that the withholding of acids in food, drink and medicine, and the substituting of alkaline remedies in cases found to be deficient in blood alkalinity, has changed, in a few hours, the condition of a patient apparently beyond aid, to one of convalescence. We must certainly regard the giving of acids to cases deficient in alkalinity of blood as equivalent to administering poison. The converse of this proposition is, of course, equally true. The writer feels that, having had years of observation and the experience of many practical tests proving the value of this point, he is simply doing his duty in asking that more attention be given to it by physicians in their treatment of disease. By so doing we shall be but adding to our unhappily scanty store of knowledge one more means of determining exactly pathological conditions which, when understood, may enable us to aid nature in correcting them.

The writer may be pardoned for reporting one out of many cases illustrating this point. It was that of a man with double croupous pneumonia. We found him bolstered up in bed gasping for breath, with windows open to furnish all possible oxygen to his blood, now being fast saturated with carbon dioxide: expectoration copious,

a pint or more in twenty-four hours of the characteristic gelatinous, albumen-like compound which is best described as liquid protoplasm. Urine scanty and high colored, temperature and pulse as always found in the most severe types of this disease. Our tests revealed the following: The expectorated matter strongly alkaline, saliva acid in reaction, urine deficient in salts and hyperacid in reaction. The blood, then, in this case was plainly being drained of its alkaline salts, lost to it in the expectorated material, and the drain was so excessive that the urine by the conservatism of nature had ceased to eliminate any alkaline salts. The acidity of the saliva was a secondary result of its being deprived of its alkaline salts, caused by the paucity of these in the blood, and the attendant carbon dioxide poisoning.

Now, from what we know of the effect of acid upon the blood, how can we regard or justify their administration in this case, say in the form of a lemonade or sour wine, or of an acid medication? A further reduction we know would take place in the blood alkalinity attended with more carbon dioxide poisoning, with a complete paralysis of the nerve centers of respiration, already so nearly overwhelmed, and death would end the scene. Yet this man was calling for just this kind of drink and his attendants were firmly convinced that there was no harm in lemonade. However, acids were forbidden and alkaline

remedies administered, both in the form of ammonium chloride and sodium carbonate. Under this treatment, which was simply to enable nature to maintain the alkalinity of the blood, we found at the expiration of due time that there was less sense of suffocation, and the patient was able to take a few moments rest from his labor of breathing, and to sleep. He still, however, begged for something sour to drink, and contrary to orders, his wife gave him half a lemon to suck. Mark the result, and his own words in telling the effects are most graphic. He said that in a few moments after taking the lemon juice it pinched his throat, seeming to shut his windpipe and he thought he could not breathe. When seen a few hours after this, his condition seemed more critical than at first. The alkalies were given in increased quantities with the addition of ammonium carbonate, and in a few hours relief was obtained.

Fortunately the man seemed bound to make himself a martyr to science, for after several days of steady improvement he again resorted to acid. This time he sucked the juice of what he was told was a sweet orange, but which in reality was super-acid and which undoubtedly represented as much acidity as the half of a lemon. The effect was the same as in the first instance. The feeling of suffocation returned and from having been able to recline in bed he was again obliged to resume his

semi-prone position. The effect was so plainly the result of taking the orange that the man himself recognized it as the cause of his trouble, and required no further caution as to the use of acids. The condition this man was in, it may be remarked, was one in which champagne would seem to be indicated, and is recommended by the best authorities. This represents acids either free in the wine, or produced in the stomach by the fermentation of its sweet elements, and it can be readily seen how, by thus introducing acid into the system of a patient in this condition, with a view to sustaining the heart's action, a directly opposite result would be induced, and the more the heart failed by the reduced alkalinity of the blood caused by the acid of the champagne, the more need there would seem to be for the wine, by any one not recognizing the harmful effects of the acid. The writer has, in fact, been consulted in many cases involving just this point, in which the medical attendant was aiding the disease rather than nature, by the administration of acids in beverages commonly thought to be perfectly harmless.

Leaving now these demonstrations of the noxious effects of acid on the blood, let us review the opinions of some late writers who seem to have been ignorant of Hofmeister's observations on the subject. It is doubly necessary that these opinions should be examined, because they

seem to be generally accepted. The apparently diametrically opposite statements made by some of these writers to the proven facts on this subject are very easily accounted for, by remembering that some of the investigators give us the result of tests and observations made on living subjects, others give us what may be called laboratory physiology. Both of these methods of investigation are necessary and commendable, and we must take the results attained by each and harmonize them if we can. The fact, however, that the results of purely chemical tests, and the changes attending the mysteries of life do not exactly conform, is no proof that either must be wrong. The very fact of their contradiction only emphasizes the point that there is much for us to learn.

The views thus generally accepted in this regard may be summarized as follows: When the vegetable acids enter the digestive tract with the food stuffs, or are administered as adventitious substances in the form of medicaments, they come in contact in the stomach and intestinal canal with numerous alkali compounds, consisting of the secretion from the mucous membrane and the alkaline digestive fluids. Especially marked are all these secretions by having sodium for their base. Hereupon the malic, citric, or tartaric acid forms a malate, citrate, or tartrate of sodium, according to the acid administered, and there is introduced into the blood and lymph

stream a considerable quantity of sodium malate, citrate, or tartrate. These salts by their alkalinity have a tendency to reduce the so-called "super-acidity" of the blood. What is clearly accomplished by the presence of these salts in the blood is to increase the already existing alkalinity of the blood. Clinical experience now comes to our aid, proving conclusively that the vegetable acids thus reduce the acidity of the urine and thereby decrease largely the excitation of the whole system which often comes through the reflex irritation caused by the super-acid and scalding urine.

We submit that the following must be taken into consideration as modifying these views. There seems to be from what we have learned, a difference in the mode of action within the animal economy of the salts of the vegetable acids ingested as such, and the same salts as formed by chemical reactions in the alimentary tract. When the pure vegetable acids are ingested they meet and combine with the alkaline salts secreted in the digestive tract, but these same salts seem not to be assimilated by the blood, but are decomposed, carried to and eliminated by the kidneys, and we have therefore the hyper-alkaline urine. That is to say this goes on for a time, but the continued administration of the acids seems ultimately to render the blood so poor in alkaline salts, poured out by the secretions to neutralize the administered acid, that nature has

not enough of them in reserve to render the urine alkaline, and we have the acid thrown off in the form of acid salts and free acid, giving the acid reaction to the urine.

This statement, then, concerning the vegetable acids and their salts must be restated thus. All these acids for a time increase the alkalinity of the urine, but this action is attended by a corresponding reduction in the alkalinity of the blood, and if the ingestion of acid is long continued and the blood is thus impoverished to a certain point, nature refuses to part with any more of her alkaline salts, and the urine becomes hyper-acid in its reaction, due no doubt, to the elimination of free acid. That the salts of the vegetable acids taken alone increase the alkalinity of the blood by the utilizing of the alkaline base by the animal economy is well established. Apparent discrepancies are thus reconciled and the statement of a part of the facts must yield to a statement of all the facts, by adding that the various salts of the vegetable acids which should, theoretically, be formed in the alimentary tract by the union of these acids, when ingested, with the alkaline secretions there found, have a different effect on the animal economy from these same salts, ingested ready formed in their chemical combination. And this fact is in perfect harmony with what was said in Chapter II., to the effect that nature acts upon saline substances which are added to food over and above the amount there in natural combina-

tion, in an entirely different manner than upon the same salts existing in normal combinations in foods.

Much of the confusion on this subject has been caused by observations made on the result of eating fresh fruits. Chemically, these are compounds containing free acid and the salts of the different acids in varying proportions, as the fruit may be more or less mature or ripe. The kind and amount of acid differ also with the kind of fruit, of course.

It seems appropriate here to refer to the cure of rheumatism by using vegetable acids, either by drinking cider or eating lemons, a subject which has been so much discussed, as being an apparent exception in therapeutics. Alkalies are conceded to be demanded in this disease by all authorities and this is confirmed by clinical experience. It cannot, however, be gainsaid that some cases of rheumatism have been cured by the use of cider or lemons. These cases, however, are, be it noted, in the chronic state. The cure, from what we have learned, can now be rationally explained. It was due to the alkaline salts of the vegetable acids which were taken up by the blood, thus increasing its alkalinity, the free acid swallowed acting a negative part or, it may be, the part of a microbe killer. This fact will be referred to again.

We can assume that there may be a time in the course of every attack of rheumatism when

cider or lemons might effect a cure. That time is when it has reached the chronic condition and the blood refuses to part with any more alkali to neutralize free acid which may be ingested, but is ready and eager to appropriate any alkali that may come to it in the form of acid salts. That this is what undoubtedly does take place is made more evident when we remember that the dried ash of lemon juice contains as high as fifty-four per cent of potash. Cider contains only a fraction of the amount of free acid found in the lemon juice, and a very much larger proportion of potash and also other alkaline salts. According to this, then, the cider treatment for chronic rheumatism should be more successful than the lemon treatment, and the experience of the writer is probably that of every other physician, that the cures by the use of the former outnumber those effected by the latter as ten to one. It may be asked in passing, if it is the free citric acid of the lemon which effects the cure, why have not tamarinds been used, since they contain from two to three times more of this acid than lemons?

As further proving the importance of the topic, let us note that nearly all researches made or being made on the blood, pay no attention whatever to its condition, as to alkalinity. Most of the work is being done simply with the microscope, and consists in counting the corpuscles and noting the different appearances they

present under varying conditions. It is submitted that these various changes may often be dependent on a departure from normal of the saline constituents of the blood plasma. It certainly must be admitted that it is possible to reduce the alkalinity of the blood and thus influence nature's vital functions by the ingestion of free acid or acid generating substances either in food or drink or as medicine.

We, therefore, are compelled to call attention to the harm that may result by following the stock instructions given by most writers on dietetics, advising the propriety of giving lemonade, or tamarind water, or other drinks made with acid, in all cases of fever. The following are the words of a new book which may be quoted as the latest authority on this subject. "Sour lemonade constitutes one of the most useful and refreshing beverages in fevers." We submit that such a sweeping statement is not accurate, nor justified by what we know to be the pathological condition attending certain fevers, and hence this advice may be the means of doing infinite harm. The attention of the writer has just been drawn to an exhaustive article by one of our most able and authoritative writers on typhoid fever, in which he very correctly calls attention to the hyper-acidity of the urine and the excessive alkaline reaction of the dejections, but in spite of this, when he details his treatment, he advises water or tea made acid with lemon juice, as a

constant drink for the patient. What would be the result, one may stop to ask, if the patient had a hemorrhage from the bowels, increasing his thirst, of course, and consequently his consumption of lemonade, knowing, as we do now, that acids tend to destroy the coagulating power of the blood, nature's own resource for checking bleeding?

This article appeared in December, 1894, but there are indications that a proper view of the subject is coming and that a due appreciation of the views we are advancing is certain to obtain. We will now quote from an article written in October, 1895, by Dr. A. Monae Lesser, of New York, giving the results of his treatment of typhoid fever, which among other valuable points embraces this important one.

He says: "In all these cases water, with a trace of sodium chloride not sufficient to affect the taste, is given ad libitum; it is readily absorbed, restoring to the blood the fluids which the intense feverish condition robs from it." He might have added that it helps also to restore the saline elements which the febrile condition robs from the blood, and we may add that the addition of the sodium carbonate or phosphate to the water would be physiologically more accurate. Dr. Lesser certainly appreciates the danger of embarrassing nature in her efforts towards recovery, by administering acid drinks in a case of typhoid fever, where their use can only work

harm, and he had the courage also to disobey late and leading writers on the subject.

A late article by Dr. W. T. English, of Pittsburg, Pa., on "Cardiac Instability Due to Acid Auto-intoxication," shows that much attention is being drawn to the subject of the action of acids on the system in various disorders. He says, "Many abnormal heart phenomena are due to acid accumulation, and acid excretion is contemporaneous with cardiac and vascular irritability. Dyspepsia offers a good illustration of the effects of acid excess on the heart. First of all, we have a sort of cardiac exhilaration, then a shortened systole, and finally a lessening of ventricular force. Reduced alkalinity of the blood also leads to capillary spasm. Similar results follow the exhibition of acid remedies. The excess of acid may be stored up in the liver, but this organ has an eliminative power, as has also the bowel. Not so, however with the heart, as it cannot eliminate, and consequently bears the brunt of the strain. Many people live on the acid line, so to speak. Ordinarily they do well, but increase the acid by drugs or food, and they suffer. The acidity of the body is normally greater during sleep and the fatalities in heart diseases commonly occur at those hours when the normal acid tide is at its height."

It may be appropriate here to call attention to the method which has, in the writer's experience, proved most convenient for determining

the reaction of the various fluids of the body. He imitates Liebreich's plan of using plaster of Paris plates, but has improved the method of preparing them, he thinks, so that they are easily used at the bed-side for testing all the fluids of the body. He was led to this because the testing of the blood for bed-side diagnosis is at best difficult and unsatisfactory for many reasons, which those who have attempted it will admit. Fortunately we can determine its condition as to alkalinity by the reactions of the other fluids of the body, viz.: the urine, the saliva, the perspiration, the expectoration, and the dejections, and to these the test can readily be applied.

In making the plates, the best grade of dental plaster, absolutely free from either alkaline or acid reaction, is used. This is cast upon a plate of glass in order to give a smooth and polished surface. The thickness is conveniently three or four millimeters. This is cut, before it has fully set, with a tin punch into disks which may be conveniently made about the size of a twenty-five cent piece.

These are prepared for use as follows: A solution of litmus, say one part to ten or twelve of water, is rendered slightly alkaline, or bright blue, by the addition of a few drops of aqua ammonia. The plaster plates are then painted with the solution upon the polished side, using a wide camel's-hair brush, one or two applications being made until an even blue stain is effected.

A solution is now made of two parts of chemically pure sulphuric acid in five hundred of distilled water. We also require a small brush, some surgeon's plain cotton, a few wooden tooth picks, and a bottle of distilled water. The details in making a test consist first in scraping the dark blue surface of the litmus plate over the space of about two centimeters. We notice that the litmus, however dark the plate appears, penetrates only to a limited and definite extent, and thus by removing the outer surface we have a uniform light blue stained surface for use. The small brush is dipped into the acid bottle and drawn quickly over half the surface we have exposed by scraping, giving a field of red litmus joining the blue. A bit of cotton twisted on the point of one of the tooth-picks and wet with distilled water, when applied to the two colors, must show no action, thus proving everything to be in correct working order. Any fluid such as water, saliva, urine, perspiration, etc., may now be applied in the same manner, but blood, pus, milk and opaque fluids which would obscure the view, must at once after being applied to the plate be washed off with distilled water.

It must not be forgotten that in testing the blood for alkalinity by comparison, a fixed amount must be used in every case, and it must be tested the instant it exudes from the body. The eye of a needle may conveniently be used for handling this amount.

The plates, after their surface has been once used, may be restained with the blue litmus and thus used over and over again.

Methods and details for avoiding all sources of error will suggest themselves to any one giving the matter a little attention. For example, the mouth should be well rinsed with pure water before testing the saliva, and the secretion should be drawn by a sucking action of the tongue from the sub-lingual glands, and the first that comes should be rejected as likely to be from the ducts rather than from the glands. In all cases several tests should be made and the distilled water can always be used as a control test. It is wise for the beginner to make repeated tests upon the secretions of healthy individuals in varying circumstances, before studying those of diseased conditions. The writer wishes to call special attention to the delicacy of the test and also to the fact that the blue stain retains its activity indefinitely if the plates be kept in the dark and protected from acid fumes in the air, but that the red litmus must be prepared as directed, at the moment the test is to be made, as it soon loses its power. The ordinary red and blue litmus paper, however freshly made, will fail to reveal reactions which by this test can be made most obvious. The coarseness of the litmus paper test and the unsatisfactory results attending its use are undoubtedly the cause of the want of uniformity reported by different observers as

obtained in similar conditions, and this accounts, no doubt, for the neglect into which the matter has fallen.

The writer wishes here to call attention to the amphoteric reaction of the morning urine, which this gypsum litmus test, from its delicacy, makes so readily apparent, for it is from the condition of the urine, as to its acid, alkaline, or amphoteric reaction, that, in the author's opinion, so much can be determined as to the state of the blood as to its alkalinity. Hence it becomes a ready method of deciding what articles of diet may be required or what form of reaction in medication is indicated. All our works on the urine state that the normal reaction of human urine is acid. By the coarse test of litmus paper this is true, but it is only half the truth, for it should have also the alkaline reaction; that is, it should be amphoteric. The writer has made many hundreds of tests of the urine and the results of them he desires to formulate as follows: *The morning urine of a person with healthy digestion and excretion and taking proper food and drink, is invariably amphoteric, and in equal degrees, as shown by the equal intensity of the reaction on the blue and red litmus.*

We may also have amphoteric urine containing an abnormal amount of saline matter. The amount of such salts in the urine must of course be taken into account and determined in the usual manner. The amphoteric reaction test is

always to be considered in connection with the usual regular tests made of the urine.

It does not necessarily follow that because a person's morning urine is amphoteric he is therefore free from disease. It simply reveals the fact that in so far as the alkalinity of the blood is concerned he is in the normal condition, and therefore that the food and drink being ingested are proper in character and combination for nature's wants in that particular case (if also the amount of solid matter in the urine is found to be normal.) There are many diseases, notably in the chronic forms, in which, with a proper diet, the alkalinity of the blood is not changed, and yet the very fact that by means of this test a differential diagnosis can be accurately made in some diseases is certainly of no small importance. For example, in chlorosis there is a deficient alkalinity of the blood and also the same condition in anæmia from digestive disturbances. Given then, a case of persistent anæmia with the proper alkalinity of the blood maintained, and it reveals the correct diagnosis of the case to be the incipient stage of some serious constitutional trouble. It generally proves to be tuberculosis; thus a prognosis can be made long before physical signs would justify this opinion. This is certainly a point of great practical value, and if no other results are obtained by recognizing the normal amphoteric condition of the urine, this alone would demonstrate the importance of giving the

subject careful attention. The morning urine is used in determining its reaction, because the acid tide is at its height at this time. At other periods of the day, of course, and under certain conditions, we know the urine to be normally alkaline in reaction. This is so, for instance, just before a meal, or in any case in which no food has been taken for a number of hours. In these circumstances an amphoteric condition of the urine must be interpreted as one of excessive acidity. So in the case of a nursing infant whose urine should normally be alkaline, if it proves to be amphoteric, this should be treated as abnormally acid.

In the writer's experience it is in the great class of dyspeptics that this test of the urine is most valuable, as it enables the physician to determine exactly the type of the disorder. As Dr. Albert Mathieu, of Paris, says in his work on Diseases of the Stomach and Intestines: "The knowledge which we yet have concerning the chemical process of gastric digestion is very incomplete. We know unfortunately even less concerning intestinal digestion and it is only indirectly, by the examination of the excreta, that we can judge of the condition of the secretion and of the digestive work performed by the intestine and its appendages." It is submitted that the test of the reaction of the urine, when interpreted understandingly, will locate at once the seat of the trouble in dyspepsia, and at the same time

point out the proper diet to overcome and correct the disorder. As the state of the stomach as well as that of the intestine as to acidity or alkalinity can be determined by the reaction of the urine when taken into account in connection with the physical symptoms described by the patient, it becomes at once a most valuable aid in diagnosing and treating dyspepsia in its various forms.

Dropping, for a moment, the amphoteric reaction of the morning the urine as revealed by the gypsum litmus test, let us consider why we should expect this to be so in normal man. The first fact that we must call to mind is that the urine of true flesh-eating animals is acid only in its reaction, while the urine of the plant-eating animals is alkaline only in reaction. These reactions, we must remember, are due to the elimination by the kidneys in the carnivorous animals of the acid salts and in the case of the herbivora, of the alkaline salts. An animal, then, subsisting on a combination of these two forms of diet, animal and vegetable, should eliminate urine giving both reactions from the presence in it of both the acid salts and the alkaline salts.

In the urine of man the salt giving the acid reaction is the trisodic phosphate, that giving the alkaline reaction is the disodic phosphate. That different forms of diet will change the reaction of the urine in the individual is well understood. On this line of investigation the author fortunately had the opportunity of making a test on two

omnivorous animals. One of the subjects was a hog and the other a monkey. On feeding the hog meat alone, free from fat, the urine was acid in reaction only, while on a pure vegetable diet free from an excess of fatty matter, it was alkaline, while a combination of the two forms of diet gave urine having the amphoteric reaction. In the case of the monkey the results confirmed the observations made upon the hog, the reaction of the urine depending upon the diet of the animal. Man being a mixed feeder, a flesh and vegetable eater, it follows that if these substances are in proper proportion, the kidneys in a normal condition, and excretion normally taking place, we should have amphoteric urine. Now, in man, we have seen that the excessive use of acids and acid-making food and drink (and most potent of all this class are alcoholic beverages, both distilled and fermented,) can induce an acid reaction of the urine and we know also that the eating of much meat causes the same result, therefore we must accept the necessity of limiting the ingestion of these substances in all conditions attended with hyper-acidity of the urine. There is, in fact, a direct relation of the acidity of the urine to certain diseases, which is well established. In typhoid fever the acidity is more or less marked as the temperature is higher or lower. In rheumatism and gout the presence and intensity of pain seems to be in close relation with the acidity of the urine. In pneumonia

and pleurisy the urine maintains a high degree of acidity varied by the severity of the attack. We find also an acid urine in the majority of those suffering from the acute fevers, and it is most marked in those cases in which emaciation is rapidly going on. The urine of a lithæmic or one suffering from a so-called uric acid flood, is, of course, acid in reaction, and just in proportion to the gravity of the attack, and it is equally true that just as the urine becomes amphoteric just to that degree health and well being return.

It is interesting to note that the author's view on the relation of the reaction of the urine to the alkalinity of the blood has been confirmed by Dr. Alexander Haig, of London, since this article was written. In the last edition of his work on "Uric Acid as the Causation of Disease" he says: "With a decrease of alkalinity of the blood there is a corresponding increase in the acidity of the urine, which therefore indicates the condition of the blood."

This brings up the subject of the part taken by uric acid in the causation of many ills. The fact that there is such a great difference of opinion among writers on this topic is proof enough that there is little positive knowledge on the subject. This is made further apparent by referring to the two theories on the formation of uric acid, as propounded by Haig and Roberts, which theories, it will be noticed, are diametrically opposed. The uncertainty on the subject is still

further emphasized by the observations and experiments lately made in Germany by Horbaczenski, whose theory of the origin of uric acid is that of an excessive breaking down of the nuclein, from the neuclei of the cells. Leaving the uncertainties on the subject, let us seek something definitely determined. We find that late researches show that uric acid is found in the blood under various conditions, and its presence there does not necessarily indicate that the person so affected has the gout. This disproves the claim that uric acid in the blood is diagnostic of this disease only. The general consensus of opinion now seems to be that this so-called uric acid diathesis is more a matter of defective elimination than of over production, and how important the alkalinity of the blood is for free elimination we have already shown. It is also now conceded that acid, not necessarily uric, is responsible for a very large number of the derangements of health which are manifested in many different ways, among which may be mentioned neuralgia, headache, migraine, myalgia, dyspepsia, skin diseases, acute inflammation, arterial and renal diseases, and various lung and bowel troubles.

In view of the confusion which arises in attempting to discuss this matter under the head of "uric acid," it may be wise to drop this name and use the term "acid diathesis," and to speak of "acid diseases," meaning those in which there

is an abnormal amount of acid in the body, either introduced from without or generated within the system, and attended with a reduction in the alkalinity of the blood. The use of the term acid diseases will very consistently place gout and rheumatism in the same class and the dietetic rules for both diseases are the same. The diagnosing of all acid diseases will be more accurate and satisfactory, because the abnormal presence of acid in the excretions and secretions can be so readily determined by the tests we have described. We have then only to regard changes in the alkalinity of the blood as being the true cause of all this class of diseases.

It is very interesting to note just here, that the simple "catching cold" is attended with and marked by an acid condition of the excretions, and hence, theoretically, the administration of alkali is the proper remedy, and in practice it will be found that there is nothing that will act more satisfactorily in such cases than the free use of carbonate of sodium, thus going to establish the truth of what we are maintaining. It may fairly be assumed that no one would "catch cold" if the blood alkalinity were sustained at the normal degree.

In the writer's experience, it is in this class of so-called uric acid disorders that the most brilliant results may be attained by simply changing and regulating the diet of the sufferer until an amphoteric reaction of the urine is secured,

when it will be found that the derangement of health is overcome. Both urea and uric acid, it is well known, are normal elements of the body, and are entirely harmless substances, if the excretory organs are fully able to eliminate them properly, and the proper alkalinity of the blood is admitted to be of the first importance in this work. It is proven that we can change this in a definite manner, and at our will, and thus it is possible, in a given case, to make accuracy and knowledge take the place of guessing and ignorance.

Just here it is appropriate that we should refer again to rheumatism, it being conceded to be a typical acid disease. The question lately raised of its being a germ disease will be shown, later in the discussion, to be a most proper one, germs probably being a factor, at least, in the causation of the free acid.

In studying rheumatism, two things stand out prominently. First, the hyper-acid condition of the urine, the saliva and perspiration. Second, the fact that the disorder has been recognized for years as best treated by alkalies, and more recently, and with better success, by certain antiseptic remedies, such as salol, salophen, and the salicylate of sodium, these being now as near specifics for this disease as anything in use. We are justified also in affirming that strictly in the proportion that each of these remedies has the power of rendering the contents of the small intes-

tines alkaline and free from acid-making germs, its value as an anti-rheumatic is manifested. Taking now, a third condition attending rheumatism, namely, the reduced alkalinity of the blood, and we are prepared to formulate a pathology, confirmed by our therapeutics, as follows: Rheumatism is primarily caused by the prolonged acid condition of the contents of the small intestine. This condition may be induced by hygienic errors, the chief of which is the ingesting of acid and acid-making food and drink, and the preventing of the elimination of acid waste-products by exposure to cold and dampness. In a certain number of cases (about thirty-four per cent) it is found, however, that there is a persisting tendency to this acid condition of intestine contents due to what may be assumed, in the absence of positive knowledge, to be some constitutional defect in the digesting and excreting organs.

This continued acidity of the intestinal contents (due to the presence of acid-making germs,) nature is constantly neutralizing, but at the cost of such a loss of the alkaline salts of the blood that the diseased condition called rheumatism supervenes. It is apparent then that the alkaline treatment of this disease is in the correct line, in so far as it restores the alkaline salts lost by the blood, but if the acid-making germs are left still at work, the disease cannot be said to be conquered until these are overcome. Thus we

may understand the happy results attending the use of remedies like salophen, which, being divided when in the small intestine into phenol and salicylic acid, applies two powerful germ destroyers precisely where they are needed to overcome the primary cause of the disease. This cause, as before remarked, is the prolonged presence of germ-made nascent acid in the small intestines, just at the point where peptone is being converted into serum albumen for absorption by the blood, a change which can be effected only in an alkaline medium.

Concerning the writer's view of the microbic nature of rheumatism, he quotes in confirmation of it the latest opinion of Sir Dyce Duckworth, as given in the British Medical Journal. "Under conditions of lowered vitality, persons predisposed to rheumatism become a prey to infection by some microbic organism, specific in character, which generates a toxine whose ravages are specially determined to joints and serous and sero-fibrous tissues generally. It is not improbable that the product of this bacillary germination is lactic acid in large amounts, the existence of which in rheumatic fever is well ascertained. The marked beneficial influence of the salicylate salts is probably due to its germicide properties, which are particularly specific in controlling several of the most marked effects of the peccant material in rheumatic fever."

In a previous chapter reference was made to

the cure of rheumatism by the use of lemons or cider, and their beneficial action was attributed to the alkaline salts the blood derived from them. We may now, however, fairly ask whether these substances may not possess a specific germ-killing power which has aided in, if not entirely effected the cure. We may not be justified in asserting that we can promptly restore to health a person suffering from rheumatism, but we can truly say that we can render a person having the susceptibility far more likely to be attacked, by administering certain acid-making, germ-breeding forms of diet; and we are equally sure that we can do much to prevent such a one from having the disease by prescribing proper food and drink, other conditions being the same. If this proposition be doubted, we simply ask the doubter to substitute the word gout for rheumatism, and he must then concede that the statements are all plain truth. If any one still fails to appreciate the value of a proper diet as regulating the quality of the blood, let him deny if he can that it is possible to produce scurvy in any one, old or young, by an improper diet. This thought leads us to remark how many children suffer from what is mild infantile scurvy, the victims being dosed with tonics, acids, iron and the like, when they are simply suffering from a deficient alkalinity of the blood, and require only a properly arranged diet to be restored to health. The reason that the true character of

the disorder in these cases is not suspected, is due to a want of knowledge among medical men as to what scurvy is. They associate the disease only with persons confined during long periods on ship board, or with armies cut off from their base of supplies. They would not dream of looking for scurvy in the case of a bottle-fed infant, whose parents possess every luxury; yet in these conditions it will most likely be met with, for this same child will be found to be taking some of the many proprietary and artificial foods sold on the market, the cost of which may render their use impossible by poor people. These proprietary foods, from their artificial combinations, lack the very element of freshness which in some way is essential to maintain the alkalinity of the blood, and the want of which, as we have shown, is primarily the cause of scurvy, and therefore the source of the mischief in these cases. We call attention to the valuable testimony of Dr. Fruitnight, of New York, on "Infantile Scurvy," in which he says: "Proprietary foods are the apparent cause in nearly all cases of this disease. The cause is a deviation of the chemical composition of the blood. This may be remedied by proper diet."

All this we submit can best be accomplished by so regulating the diet that the urine gives the normal amphoteric reaction, for thus we shall know that the ingestion of proper food and drink, and the elimination of waste products are

normally balanced. We must remember that an attack of any of the disorders caused by the reduced alkalinity of the blood never comes suddenly. Nature always makes a gallant struggle to maintain the alkalescence of this fluid, lasting, it may be, for weeks and even months, and she gives us signals of the impending trouble, which ignorance alone prevents us from heeding. It is this slow yielding of nature to deranging elements in the animal economy, which accounts for the regular periodicity which frequently marks attacks of all this class of diseases, a certain length of time being necessary for the blood to lose its alkalinity to the disease-producing point.

CHAPTER IV.

THE FOOD OF PRIMORDIAL MAN. THE CLASSIFICATION OF FRUITS, AND THE PROPER AND IMPROPER USE OF THEM.

It seems logical, from what has been thus determined to be the action of acid on the animal economy, that some consideration should be given to the uses of fruits, fresh, dried, and preserved, appearing, as they do, so commonly on our tables in one or the other of these forms. It is the fashion to begin the morning meal with more or less fresh and almost invariably acid fruit, which it is expected shall be eaten while breakfast is being prepared. This meal generally begins with a cereal or starchy food, directly following the acid fruit, the digestion-inhibiting effect of which latter has been fully demonstrated in Chapter II. Yet there are scores of people, from the frail, anæmic-looking school-girl, to the florid and robust man of business, who assert that they could not eat breakfast if they did not have some sour fruit with which to stimulate the appetite. This is most frankly said. We need not look into the by-ways of life to find a number of fellow beings who insist on taking, in lieu of appetite-making

sour fruit, one or more portions of more or less strongly alcoholic beverages, generally known as "bitters" or "tonics," but when taken before eating usually called "appetizers." If it be suggested to them that such a proceeding inhibits digestion and irritates the stomach, they reply that they could not eat breakfast if they had no bitters with which to stimulate their appetite. The acid fruit and the dram of bitters, then, are taken for the same purpose, and there need be no hesitation in saying that any individual who is compelled to begin a meal with either in order to stimulate the stomach is on the high road to disordered digestion, with all its aggravating complications, which will sooner or later make serious trouble.

No doubt, in many cases, the stomach may be said to be asleep when the breakfast hour arrives, being in a state of contraction, as it should be, and the functions of digestion in abeyance, because the secreting glands are naturally and properly resting. This is the more likely to be true if a late and full meat dinner was taken the previous evening, compelling the stomach to continue its work until nearly morning. There is no reason why this organ should be rudely awakened when it is resting, and forced at once into hard labor. The heavy breakfast seems to be a peculiarly American custom, probably arising out of our business methods, and the tax on our nervous force of our daily duties.

Our aim here, however, is to explain how a proper diet can be adapted to our habits. It is observed that in other countries, where the custom of a full evening dinner prevails, the first morning repast consists of a cup of coffee or chocolate and a roll. The regular breakfast is taken at eleven or twelve o'clock, when the digestive system, invigorated by the proper rest it has had, is ready to take up its work in a normal manner.

Of course we must take food, but this does not carry with it the necessity of stimulating the stomach and creating a false appetite for breakfast. It would be far wiser, more strictly physiological and less harmful to eat nothing in the morning unless natural hunger made the demand, and to postpone the morning meal until a desire for it was felt. As a matter of fact, the author has in many instances corrected a faulty digestion and relieved many long suffering dyspeptics by directing them simply to omit their breakfast. This is in strict accordance with what has just been said as to the quiescent or resting state in which the stomach seems often to be at the breakfast hour, and the harmful effect of rudely awakening it by stimulating appetizers.

The old saying that "fruit is gold in the morning, silver at noon, and lead at night," is simply built on its stimulating and irritating power, for if fruit really has any virtue as a direct digestive agent, or aids nutrition in any

marked degree, it should be gold at all times equally.

Another belief that is wide spread and has much to do with promoting the use of acid fruits, is the theory that man is, by nature, a fruit-eating animal. This word "fruit," in its literal, botanical and general use, as distinguished from the word "vegetable," it is difficult to define without confusion. All fruits are vegetables and many vegetables are fruits. Illustrating this difficulty of distinction it is interesting to note that during the year 1895 the Supreme Court of the United States was called upon to decide whether the tomato was a fruit or a vegetable, the decision being necessary to determine its classification for import duty. The court quite properly determined it to be a vegetable. In further illustration of the absence of any well marked distinction between vegetables and fruits, considered as elements of food, the writer's attention is called to a late and exhaustive work on dietetics, in which the author classes the cranberry as a vegetable, and the melon as a fruit, but places all the other varieties of the pepo family, the pumpkin, the squash, and the cucumber among the vegetables. By way of establishing a distinction which will be most convenient in this discussion, and as scientifically accurate as possible, the following is suggested:

All succulent fruits produced by annual plants,

as well as the stalks, roots, leaves and tubers of any plant, used by man as food are vegetables.

All succulent fruits produced by perennial or biennial plants, and used as food are fruits.

The ripened edible seeds of leguminous and graminaceous plants are vegetable food, as are also nuts, which are the dry, oleaginous or starchy fruits of perennial plants, in which the epicarp is lignified.

It is with the first two definitions that we are now engaged. A moment's consideration will show that this definition separates vegetables from fruits by a natural division, marked by the almost entire absence of acid among vegetables. Although many vegetables are sweet, none of them contain any of the true fruit acids. The fruits, however, almost without exception, contain free acid during their growth. In some, by the process of ripening, this is eliminated, and they become sweet fruits. In others again, an excess of free acid remains even after full maturity. These are the sour fruits. Others again show at maturity only a slight trace of free acid combined with much saccharine matter. These are the sub-acid fruits, the quantity of acid being so small that it serves only as a flavor.

It is an interesting fact that the indigenous food-fruits of tropical regions are very sweet, with an absence of free acid. Travelers, comparing them with the fruits of the temperate zone, pro-

nounce them insipid or too sweet. Some of them, however, possess the richest flavors, due to ethereal oils generated in ripening. The mangosteen, of Borneo, and the durian, of Java, are declared to exhibit a perfect blending of all the delicious flavors of all the most delicate fruits, and, some have said are well worth a journey to those distant islands for the pleasure of tasting. Considering this statement of the absence of acids in tropical fruits, it should be borne in mind that the lemon and orange, as we know them to-day, are not indigenous to the tropical region, but have been developed through cultivation by man from the wild, hard, and bitter varieties indigenous to the temperate heights of Northern India, and have been widely introduced into the tropical and temperate regions of the world. To determine what man's food was in a state of nature, we must, of course, look to the tropical or sub-tropical regions, because here alone a constant, uninterrupted supply of all forms of food is provided by nature. Those then, of which man in his primitive state made use, must, indubitably, be his natural diet.

It is no more than just, therefore, to begin observations with the inhabitants of Polynesia.

First.—Because here our earliest explorers found some of the finest specimens of physical manhood ever known (the Samoans at the World's Fair demonstrated this), showing that their food must have been entirely adequate to nature's

demands. These islands, too, were the last to be brought into communication with modern civilization, with its attendant diseases and vices, and hence furnish the best examples of man in his natural state.

SECOND.— There are reasons for supposing that this part of the world has been the habitation of man as long as any part of it, if, in fact, it was not the cradle of the race. In proof of this, it is only needful to call attention to the remarkable series of ruins and monuments found here and there, from the extreme northern end to the farthest eastern point of Polynesia, covering a distance of seven thousand miles. In the Ladrone Islands, the Caroline Islands, the Friendly Islands, and on Easter Island, all widely separated each from the other, are found extensive stone walls, terraces, and gigantic stone images and columns. Concerning the people whose work these are, not the faintest tradition remains, and to their place in history ethnologists have found no clue. On Tonga Island stands a monument consisting of two large stone pillars, forty feet high, and resting on their summits extending from one to the other, is a long stone slab, and on this stands a huge stone bowl. All this seems the more wonderful when it is found that no such stone is found in the vicinity; hence this must have been transported there by sea. Moreover, some of those islands show by their geological structure that they must be very old, while others

are of comparatively recent formation, so that we here have the shadowy past and the living present before us for observation and study.

THIRD.—We find the inhabitants of these isolated islands presenting wide racial distinctions, and if, under these conditions, the same kinds of food are used, the fact will go far to establish the character of the normal food of primitive man.

FOURTH.—These regions are selected because there the delightful climate, the absence of disease, of poisonous reptiles and of ferocious beasts, placed primitive man in most favorable conditions. Besides a suitable climate and food, nature also provided him with what may be called ready made houses and clothes, for the bamboo, the palm and the lace tree, or paper mulberry, may be converted by man, in a few hours, into convenient shelter and garments. Those who visited the native huts of the Samoans at the World's Fair, will fully appreciate this point. As illustrating how perfectly some of the island regions of the Pacific ocean seem adapted for supplying all man's needs, and how the idea has impressed visitors, reference is made to "The Cruise of the Sunbeam," by the late Lady Brassey. She was a world-wide traveler, and gave as the result of her observations that Tahiti, one of the Society Islands, was the most beautiful spot and most perfectly adapted to man's habitation on the globe.

Beginning with the Ladrone Islands, it is found

that the diet of the original inhabitants was bread-fruit, cocoanuts, birds, fish, mollusks, crustaceans, bananas, and arum or taro. The food known as taro on some of the islands is prepared from the root of the arum esculentia and other varieties. On other islands, the words taro, kalo, or poi are used to indicate a food made from the root of the colocasia esculentia. This is a variety of water lily resembling the calla lily, growing in mud and water. The root when cooked forms a gelatinous starchy food of great value, so much so that it is said a patch of it forty feet square will furnish sufficient food for one person for the entire year. The stalk is cut from the root when the latter is gathered, and, replanted, soon develops a new root; so that when a patch has been dug over from side to side the process can be repeated for six years without renewal. The arum furnishes tuberlike roots which, when cooked, form a starchy food of such highly nourishing properties that four pounds of it are said to be equal to fifteen pounds of meat.

It is interesting to note that plants belonging to the arum family are indigenous to nearly all parts of the world and wherever found have been used as food. The aborigines of North America made extensive use of the root of the arum triphyllum, as an article of food, drying and storing it for winter use. The plant is to-day called the Indian turnip for this reason. Several varieties of arum are indigenous to all parts of the

eastern hemisphere, and have furnished food for man so widely that this starchy form of food may be said to have been to primitive man what the potato has been of late years to Ireland, but with a nourishing power far superior. The word banana, as here used, must be understood to include all the numerous varieties of the great plantain family, of which it is a member, some forms of this fruit being suitable for use in their natural state, and others again only when cooked or made into flour.

In the Caroline Islands the food of the native is found to have been arum, bread-fruit, cocoanuts, bananas, turtle, fish and other sea food.

In New Guinea or Papua, the chief articles of diet were the arum, the sago palm, the wild hog, tree kangaroo, wild pigeons, cocoanuts, bananas, fish, turtle and shell fish.

On the Marshall Islands, primitive food consisted of the fruit of the pandanus, or screw-pine, the arum, cocoanuts, wild fowl, wild sugar cane and fish.

On the Gilbert Islands, the natives lived upon pandanus, arum, fish, cocoanuts and wild fowl.

The aborigines of the Samoan Islands, were found living upon arum, yam, plantain, pandanus, bread-fruit, wild fowl, birds, fish and sea food.

The original foods on the Friendly Islands were the arum, the yam, cocoanut, bananas, bread-fruit, wild hog, birds of all kinds, and sea food.

The natives of the Society Islands lived upon arum, bread-fruit, bananas, cocoanut, plantain, wild hog, wild fowls of all kinds, fish, mollusks and crustaceans in great variety.

On the Hawaiian Islands primitive foods were arum, pandanus, bananas, bread-fruit, cocoanuts, wild hog, fish, fresh and dried, and wildfowl.

The Fiji Islanders were found in their primitive state living upon arum, yam, bananas, bread-fruit, cocoanuts, wild hog, plantain, birds, fish, mollusks and crustaceans.

Search elsewhere throughout the world will add to the list of foods for primitive man the manico (a starchy root), wild millet and rice, several different varieties of yam, and in Arabia and Nubian Africa the date, as constituting the staple foods, with an increased consumption of animal food of greater variety.

In summing up the subject we must be struck with the universal and extensive use of animal foods in the hottest regions of the earth, where we have been led to believe a diet of fruits would prevail. In fact, from the equatorial islands of Polynesia, across Tropical America, through the torrid regions of Africa and Asia, primitive man is found everywhere eager to feast upon the flesh of every form of animal life, on sea or land, from the lowest to the highest. That this was equally true of the inhabitants of the temperate regions, the contents of the ancient bone caves and the kitchen middens most forcibly testify.

Considering food from the vegetable kingdom, no authority is found for the statement so generally made that primordial man subsisted largely on succulent sweet fruits, but on the contrary, in the hot regions where many of these fruits are indigenous we find that he has refused them as a staple diet. A moment's thought will give us the reason for this fact.

FIRST.—Because they contain nearly ninety per cent of water, the rest being sweet and flavoring elements, while they lack many of the elements of nutrition.

SECOND.—This peculiar combination of water, saccharine and other organic matters is one that is prone to fermentation, thus being converted into acid in the alimentary tract, producing bowel disorders, which are especially likely to prevail in hot countries, so that even there their limited or occasional use is attended with danger. It was sad experience, no doubt, that led primitive man to make animal and starchy food his staple diet.

The purpose and use of the succulent sweet fruits and their office in nature is the question which now arises. This may fairly be assumed to be that of food for the birds of the air. In support of this suggestion it may be noted that in all the South Sea Islands there is a peculiar family of indigenous birds, known as the fruit-eating pigeons, and the flesh of these forms a very important part of the food of the natives. These birds, feeding upon the succulent sweet fruits,

and flying from island to island, are themselves eaten by man, and thus fulfill the office of the herbivora of other regions, that of converting vegetable matter into meat for man's use.

It is further worthy of remark that all animals whose natural diet is succulent fruits have wings, showing that nature adapted them to seek their food in the tree tops, and to traverse long distances in search of it. They also possess certain anatomical peculiarities which fit them for subsisting on fruits. The toucan and the hornbill are examples of this class among the birds. Outside of the birds there is but one family of frugivorous animals, viz.: the fruit-eating bats of the tropical regions, of which the fox bat is the largest and best known. All members of this family have an arrangement and shape of teeth peculiar to themselves and different from the teeth of all other bats, plainly adapting them for feeding entirely upon succulent fruits. The statement, therefore, that all frugivorous animals have wings is scientifically correct. It is generally believed that monkeys subsist on fruits in their native haunts. This is not so. The natural food of the monkey, wherever found, is first, animal, such as lizards, grubs, eggs, young birds, etc., and next nuts, roots, and vegetables, according to the production of the country of his habitation.

It is thus determined that man in his primitive state subsisted on flesh, fish and foods which he found in the roots and grains we have noticed,

with saccharine matter combined with other nourishing principles, as in the banana and date, and the fatty matter in the cocoanut. According to the definition of edible fruit, the cocoanut is not to be considered under that head, being properly a nut, though the soft and immature pulp is consumed to some extent, after the manner of a dessert, by the natives of those countries where it grows. It is as an ingredient of "made dishes" and for its oil, however, that the cocoanut is so universally used by them. It may be said to occupy the place among savage races that butter does among civilized nations, with the added advantage of containing a large quantity of albuminous matter as well, so that the combination of the meat of the cocoanut with the starchy matter of arum and the yam forms at once a perfect food. The bread fruit and the banana are sweet, starchy fruits, but the former is treated after the matter of a vegetable, being gathered and cooked before the starch in its composition has been changed into sugar by ripening. Its nourishing power, however, is far inferior to that of the arum and yam, and we must not fall into the mistaken notion of supposing the bread-fruit, because so-called, is a staple article of diet; it is only used by the natives during certain seasons of the year.

We propose now to consider, generally, the fruits in common use. Their various uses have been summarized by different writers as follows:

FIRST.—To furnish nutriment.

SECOND.—As antiscorbutics.

THIRD.—To introduce various salts and organic acids which improve the quality of the blood and react favorably upon the secretions.

FOURTH.—To lessen the acidity of the urine.

FIFTH.—As laxatives and cathartics.

SIXTH.—To stimulate the appetite, promote digestion, and give variety to the diet.

Proceeding to consider these, seriatim, in accordance with our classification of fruits into acid, sub-acid and sweet, there can be no just objection to selecting the apple, the orange, and the cherry, as fair representatives of the first class, all being in general use for eating, and containing free acid in a marked quantity.

For convenience, let us take the average of their more important constituents and use that as a type of the class.

ANALYSES OF SOUR FRUITS.

	Water.	Sugar.	Albuminates.	Saline Substances.	Free Acid.	Fatty Matter.
Apple	85.	4.78	.22	.31	2.31	0
Orange	89.	4.59	.73	.49	2.50	0
Cherry	85.	4.70	.71	.56	2.75	0
	259.	14.07	1.66	1.36	7.56	0
Average......	86.	4.69	.55	.45	2.52	0

The apple referred to is a dessert variety, and not the cooking kind. These analyses give the composition of perfectly ripened specimens of the different varieties.

The lemon and grape fruit, containing, as they

do, from twelve to fifteen per cent of free acid, belong to the class of hyper-acid fruits, cannot be considered as eating fruits, and hence are not taken as fair representatives in these analyses of the class of acid fruits in common use. The grape fruit or shaddock, having in its composition a large percentage of free acid and a somewhat bitter taste, is a favorite morning stimulant for those whose appetite needs forcing. It is known in Europe as the "forbidden fruit," and many would be wise if they would so regard it. All remarks concerning free acid apply with increased force to this and all hyper-acid fruits.

For the sub-acid group, it is fair to select the grape, pear and peach for analysis, all these being in common use.

ANALYSES OF SUB-ACID FRUITS.

	Water.	Sugar.	Albuminates.	Saline Substances.	Free Acid.	Fatty Matter.
Sweet grape...	79.	13.78	.83	.36	.82	0
Pear	83.	7.94	.26	.28	.07	0
Peach	83.	4.58	.46	.42	.61	0
	245.	26.30	1.55	1.06	1.50	0
Average	81.	8.76	.51	.35	.50	0

As representing the true sweet fruits in the fresh state, we have only the banana in general use, and its composition is as follows:

	Water.	Sugar.	Albuminates.	Saline Substances.	Free Acid.	Fatty Matter.
Banana.......	73.	16.	4.85	.79	0	.63

We have, however, some dried sweet fruits in common use, the fig, the raisin, and the date, for

example, and their analyses show the following results:

ANALYSES OF DRIED SWEET FRUITS.

	Water.	Sugar.	Albuminates.	Saline Substances.	Free Acid.	Fatty Matter.
Fig...........	31.	49.79	4.11	2.86	0	0
Raisins.......	32.	54.26	2.42	1.21	0	0
Date	30.	58.75	6.25	1.23	0	0
	93.	162.80	12.78	5.30	0	0
Average	31.	54.26	4.26	1.76	0	0

The most conspicuous fact revealed in these tables is the amount of water contained in all our fresh fruits, the average being eighty parts in every hundred, or four-fifths of the whole.

Sugar is represented in the three classes by 4. 8. and 16., a perfect geometrical ratio, but this does not express their value as food, because sugar, although an important alimentary principle, is not a complete food. The best gauge of the nutritious properties of foods is found in the albuminous, or true flesh-forming substances, and in these the acid and sub-acid classes both stand very low, averaging only .53 or about one-half of one part in a hundred.

In saline matters, both groups of fruits show decided value, the average being .40. In the sour fruits the free acid presents the large average of 2.52, while in the sub-acid fruits the amount of free acid drops to .50, or in other words, the acid fruits contain five times as much free acid as the sub-acid fruits. This amount, 2.52, would be 25 parts of acid in a thousand.

The normal amount of acid in the gastric juice at the highest figure is only three parts per thousand, as we know.

Referring to the evidence adduced of the inhibiting effect of acids on digestion and their injurious effects on the blood, we are certainly justified in insisting that the acid fruits are not adapted to furnish nutriment to man, but on the contrary, an extended and liberal use of them cannot but result disastrously. Indeed, under certain conditions of the system, the ingesting of a small quantity of the fruit acids may embarrass nature's functions to an alarming degree, by robbing the blood of its alkalinity, as has been demonstrated. All these remarks touching free acid in sour fruits are lessened in force when applied to the sub-acid fruits (though still true in essence), just in proportion as they have less acid. But containing, as they do, more sugar and less acid, we have to bear in mind the danger of their fermenting in the alimentary canal, since the small amount of albuminous matter in their structure prevents their being quickly disintegrated by digestion in the stomach. Hence, the acid and sub-acid fruits cannot be taken by man in quantities sufficient to be termed nourishing. It is this small amount of albuminates scattered through so much substance, that makes the solid fruits harder of digestion than those that are soft in structure, and this is true in a direct ratio. Hence, contrary to the general belief, the apple

in its raw state is difficult of digestion for this reason, in addition to the inhibiting action of the acid it contains.

The free use of the apple has been recommended on the ground that it is especially rich in phosphates, and hence is a brain food of high value. This impression must be corrected by calling attention to the analysis given of this fruit, which shows only .31 of saline matters of all kinds, being the lowest of any fruit except the pear, and we must take into account that the assimilation of a food depends upon its digestibility. Since the apple is not one of the easily digested fruits, not enough of it can be taken to cause any marked amount of the phosphates to enter the system. The cooking of this and all other fruit, by breaking down and softening the cellular structure, overcomes the difficulty of digestion, to a large degree, but for purposes of nutrition the amount of cooked apple taken would necessarily be so great that the serious objection of introducing into the digestive tract so much material very prone to fermentation must be considered of paramount importance. In fact, all this class of substances should be eaten in amounts and conditions which should properly put them under the head of "relishes" and not of food. This would naturally render their use by any one having digestive disorders a question deserving careful consideration.

In discussing digestion, reference was made

to the pineapple and attention was called to a peculiar principle in its composition called bromelin. This is a vegetable pepsin and has the power, with acid, of digesting albuminates. This fruit, which is so extensively used, would properly be a sweet fruit if eaten fully ripened in its place of growth, but as found in our markets, imperfectly ripened, is really a sub-acid fruit, but its juice still has a peptonizing power. Hence the pineapple is the only fruit used by us, having a definite power of aiding digestion, therefore its use is to be commended in many conditions, although its nourishing properties are very small and the cellulose so abundant in its structure is of course to be avoided.

Among the indigestible substances in fruit is the silica in the pear. Many varieties have such an amount of these little gritty particles in their structure, as to be really unfit for eating in the raw state, owing to the intestinal irritation likely to be produced thereby, especially in children.

Referring again to the analysis of the fresh sweet fruits,—those marked by the entire absence of free acid,—represented by the banana only as a staple fruit in our market, there are to be noticed:

FIRST.—The smaller quantity of water it contains than either of the other two groups of fruit.

SECOND.—The double quantity of sugar held by it over the sub-acid fruits.

THIRD.—That it contains about ten times as much albuminates as either, with a marked increase of saline matter, and with also the added and important element of fatty matter, which is wholly absent in both the other groups of fruits.

It is a remarkable fact that the albuminates are present in the banana in almost the same proportion that they are found in milk, this substance, according to three investigators, containing them to the extent of 4.03 per cent. Dry wheat flour contains twelve per cent. of albuminates, and hence one pound of it would be equalled in nourishment by three pounds of fresh bananas. Were these dried and reduced to flour, one pound of this flour would probably equal two pounds of wheat flour in nourishment. The analysis of the banana then, but confirms that which experience has proved to be true, that it is a fruit of high nutritive value. In fact, it stands alone in this respect, as well as in being the only sweet fruit which can be obtained fresh and in a suitable condition in all parts of the country and at all seasons of the year.

Where the banana grows, the natives use the pulp, mixed with water, to feed infants deprived of their mother's milk. This is certainly a most practical proof of its high rank as a food. It is also dried and made into flour.

The banana has been here spoken of as if there were but one variety, and when the word is used we all think of it as meaning the kind usu-

ally displayed in our markets and hawked on our street corners. But this is doing the banana an injustice. The variety we are familiar with is classed in its native regions among the cooking kinds, and would not be thought suitable to be eaten uncooked. The more perfect and truly edible kinds of banana are small in size (one variety is known as the lady finger, for example), and of such delicate structure that they will not bear transportation. In fact, the number of varieties of the banana or plantain may be best compared to the number of kinds of weeds in a garden. They may simply be counted by dozens, while in this country we are furnished with but one kind by which to judge the fruit, and that, too, a coarse variety.

Objection is frequently made to the banana in our markets that it is brought here green and therefore unfit to be eaten, implying that like the succulent fruits it should ripen naturally on the tree. This is not a valid objection, as those starchy fruits, the bread fruit and the banana, are in their native land frequently gathered before fully grown and allowed to ripen off the parent stalk, being buried in covered pits for this purpose. The change that takes place is a chemical one simply and consists mainly in the conversion of the starch into sweet substances easy of digestion, with the formation of essential oils and volatile ethers giving the aroma. Now, the longer this process is allowed to go on, up to the very point

of souring, by so much is the banana easier of digestion, because it is thus predigested, or, more properly, is brought into that condition which results from cooking starchy foods. This is a very important point, and explains why many people complain that the banana disagrees with them. They eat it too much in a raw state, that is, when the skin is simply yellow. They think the banana is then in a condition for eating; as a fact, the skin should begin to darken and shrivel before the fruit is in its proper edible state. The difference between a raw potato and a mealy baked one is about as great, in flavor and digestibility, as that between a banana imperfectly ripened and one in proper condition for eating. We should learn by experience when the banana is at its best for eating, and use it then. Remember, also, that the banana contains so much nourishment that it would best be taken when the stomach is not burdened with other food. Further, before eating a banana, the rough surface remaining after the skin is removed should be carefully scraped off, containing, as it does, some of the indigestible ingredients of the skin.

A flour made of dry bananas is now procurable in our markets, and is certainly a valuable addition to our food stuffs, and a most acceptable form of diet for invalids, when made into a porridge either with water or milk, and suitably flavored. Its use is supported by theory and experience, for travelers in Africa tell us that for

months together, they have lived almost entirely on banana flour.

For a further illustration of the nourishing properties and acceptability of the banana by a weak digestion, the writer here quotes from a personal report he has received from Dr. William C. Ussery, of Kentucky, who says he has used the banana as the only food in cases of typhoid fever with the happiest results. He further says: "In no case did I see ill results from this solid food. On the contrary, it seemed to me the cases entered the convalescent stage with convalescence more than half established. I am not prepared to say that the course of the disease was in any way changed except what might be due to the preservation of bodily strength and repair of waste."

The writer wishes to call attention to the following extract from a standard work as illustrating the inaccuracy and want of knowledge prevailing on the subject of fruits. The author says, "The apple as an article of food is unsurpassed, except by the banana, for its nutritive properties."

The analyses given above furnish comment enough on this misstatement of facts.

The class of dried sweet fruits next claims attention. This is marked first by the comparatively small quantity of water, the largely increased amount of sugar, attended with a

slightly lessened proportion of albuminates as compared with the banana, but a decided increase in the percentage of saline matter. Except for the absence of fatty matters, their combination of substances makes them theoretically valuable and nutritive foods. Practically, however, we find objections which might militate against their extensive use as foods.

FIRST.—The raisin and the fig have each an indigestible skin and seeds which render their use imprudent in any but limited quantities, as likely to cause irritation of the alimentary tract, especially in children. The date is free from this objection, the seed being easily separable and the skin more tender and not indigestible, and containing, as it does, so large a proportion of albuminates, it is better adapted for extended use and may be classed as possessing an important nutritive value in the dried state. Dried pitted cherries, it is worthy of remark, are free from acid and when properly cooked make a wholesome and valuable addition to our variety-giving list of relishes, and should be more commonly used. The limited supply in the market and the high price demanded is the cause, no doubt, of their restricted use. Dried plums or prunes from their cheapness are in general and extensive use. They are almost entirely free from acid and have an agreeable flavor. The skin is to be regarded as indigestible, but this can be overcome to a great degree by a proper method of

cooking, which remark applies as well to all dried fruits of this kind. This consists in placing the fruit in a double boiler, adding a small amount of water, steaming until it is thoroughly cooked, and then adding the desired amount of sugar and water and boiling a few minutes. The juice of stewed prunes or dried cherries may be safely given to children in moderate quantities, and forms a very desirable addition to their dish of rice, oatmeal or other farinaceous foods. Prunes are generally regarded as a laxative and are widely recommended to regulate the bowels. This subject will be referred to later, in considering the laxative and cathartic effects of fruit in general.

The second objection to dried fruits is that referred to in Chapter I, and is due to the fact that they are in an artificial state, made so by the condensation attending the drying process, and nature refuses to accept such forms of food for purposes of nourishment, as substitutes for those in their natural state and combination, at least, for any length of time.

Concerning canned fruits, preserved fruits, jams, marmalades and jellies, it may be remarked that the eating of any of these forms of fruit as the leading or principal part of a meal cannot be advised, because they are so prone to fermentation in the stomach, and in the case of the preserves, jams, jellies and marmalades, the extra amount of sugar is likely to cause the liver to be overworked, in its glycogen-making functions.

Canned fruits may be properly eaten by adults as ingredients of made dishes, more for their flavor than for their substance. The amount of seeds in many of the jams made from the small fruits being so out of proportion to the bulk of substance, renders them practically unfit for use owing to the intestinal irritation they are likely to cause. This whole line of prepared fruits must properly be classed as acid-making substances. Some persons, by reason of the rapid motor action of their stomach and bowels, not being liable to fermentation of the contents, may partake of such things without inconvenience, while any one with a tendency to stasis of the contents of the digestive tract may find the eating of a few mouthfuls of such substances attended with the most distressing results, due to fermentation, and it would be prudent for such a one to refrain from even tasting such things with the mistaken idea that a little can do no harm, for fermentation is self-sustaining and, like fire, when once started, a small beginning may have a big ending.

The bitter orange marmalade, owing to its bitter principle, excites the secretion of the gastric juice and it also has ferment-retarding properties, which render it acceptable to almost any stomach when eaten with food as a relish. Orange marmalade is well adapted for use at lunches, particularly for school children. Pineapple marmalade is also a very wholesome and desirable

relish, having, as has been seen, a digestive power of its own. Guava jelly is very rich in pectine and contains no free acid. It is very nourishing, does not easily ferment, and may be permitted to children. A fine variety of jams, marmalades and jellies is prepared in California, which contain nothing but the fruit and pure sugar, and hence are much to be preferred to others on the market, which are so uniformly sophisticated and compounded with commercial glucose.

It must be borne in mind that all fruits and vegetables in their fresh state are anti-scorbutics, but when dried, canned or preserved, they entirely lose this property of preventing scurvy. This applies no more to fruits than to vegetables, and no more to vegetable foods than to animal foods, for, as has been hereinbefore shown, the element of freshness is the one that prevents scurvy.

The second use of fruits then, as anti-scorbutics, is fully answered in what has been said; that is, they are not necessary by any means for that purpose, fresh meat or fresh vegetables being far better, as lacking the free acid contained in many of them, which we have found to be contra-indicated. It is such statements as the following, taken from a leading work on foods, which have led to the belief that fruits alone are the only anti-scorbutics. The author says:

"Certain salts, such as the lactates, tartrates,

citrates and acetates, confer upon the system that alkalinity which appears to be necessary to the integrity of the molecular currents. The state of mal-nutrition which in its highest degree we call scurvy, appears to follow inevitably on their absence.''

This statement is misleading in asserting that the salts of the fruit acids are required, whereas it is only necessary for health that the saline elements of the blood (lime, soda, magnesia, potash, etc.,) be introduced into it by the use of fresh food. The kind of food is not essential, though fresh vegetables, rich in the alkaline salts, are the most desirable.

Under the third claim of the usefulness of fruits is found only that of introducing organic acids ''which improve the quality of the blood,'' and this is so fully discussed in Chapter II, that it is not needful to repeat here the points there established.

The fourth claim, as to lessening the acidity of the urine by the use of fruits is also fully answered in Chapter II.

Fifth. ''The laxative and cathartic effects of fruits.''

That certain fruits act as aperient medicines is not to be denied, but the fact that they have that action is no valid reason for continuing their use, any more than it would be for the daily practice of taking cathartic drugs for the same purpose.

The apple, the fig, and the prune enjoy a special reputation as laxative fruits. None of these contain any cathartic principles, but act simply as irritants to the intestines and thus cause an aperient action: the apple, by its indigestible flesh, with a more decided action if the skin and core are eaten; the fig by its hard seeds, and prunes by their tough and leathery skin, which is particularly so if eaten raw or imperfectly cooked. The more any of these are taken for this purpose, owing to nature's tolerance to all aperient substances, the oftener they must be used, and that, too, in increasing quantities, and this constitutes a serious objection to their use for this purpose, for they cause irritation of the mucous membrane of the intestine and atony of the bowel.

The sixth use of fruits as set forth "to stimulate the appetite, improve the digestion, and give variety to the diet," has, so far as the first and second claims are concerned, been fully considered in previous chapters, and it has been found that the pineapple can be said to be the only fruit containing any substance which truly aids normal digestion by converting albuminoids into peptones.

That certain fruits and jellies, when taken with certain foods, make them more digestible must be admitted, and hence their use in such conditions is not harmful. Experience has shown that with certain so-called rich meats, sub-acid

fruits are wisely eaten. Roast goose and duck are served with baked apple, roast turkey with cranberry sauce, roast pork and sausage with fried apples or tarts. The reason that this is found a digestion-aiding combination lies in the fact that the fats of the above named meats belong to the class of neutral fats. They do not normally contain enough acid to enable the alkali of the bile and pancreatic juice to change these fats to an emulsion and thus the acid eaten with the food supplies the element which in a chemical way renders digestion easy. Pork and beans are properly eaten with a little vinegar, which, although inhibiting the digestion of the starch in the beans, yet, in this combination, renders it easier of digestion by hastening the emulsifying of the pork fat, which must first be gotten rid of before the amylopsin can break down the starch granules.

In certain abnormal conditions of the body, no doubt, the fruit acids are indicated for their remedial action, but this takes up the whole subject of the use of fruits as medicines and this cannot be fairly discussed under the vague classification of improving digestion. Each case must be considered for its own peculiar reason for requiring improvement, since normal digestion requires no aid, and normal appetite requires no stimulating. The object of all that is herein said is to point the way to preserve normal digestion by avoiding those foods and drinks which are

incompatible with normal action and therefore may impair it.

The giving of variety to the diet (not a necessary variety, mark) is something in which one loses sight of the effects which such variety may have on digestion, and the whole matter resolves itself into this—is it wise to use any food or drink which by causing indigestion will work harm to the animal economy simply for the pleasure of the palate.

About everything that a man eats and drinks, from "a sandwich and beer" to pâté de foie gras and champagne, may be taken under the plea of adding variety to the diet. This kind of variation, however, is the work of cooks, who have no interest in or responsibility for the effects their very skilfully prepared dishes may have on digestion. This discussion is not addressed to those who are quite willing to undergo all the discomforts of dyspepsia in order to indulge in injurious gastronomic pleasures by eating and drinking anything they like. Those who think life not worth living without unrestricted indulgence in the pleasures of the table, we cannot hope to influence. We must remember the old saying that "hunger is the best sauce," and those who find enjoyment at the table possible only when taking rich food and drink, and who pay the penalty in the sufferings of indigestion, have no right to assume that those whose digestion is normal find less pleasure in taking proper

food and drink. Those persons who from infancy have never known normal digestion, because of the constant use of incompatible and unsuitable foods, can of course, offer no opinion on this matter, any more than a blind man can on color. It is not our aim to belittle or decry the pleasures of the table. They form a very important factor in the enjoyment of life, and the purpose here is merely to plead for a rational and proper diet, which will give all the pleasures to the palate that can be wished for, and be attended by none of the ills and penalties of a digestion-destroying diet, however pleasant to the taste.

In reality, a man with a five thousand dollar chef in his kitchen, and a butler in charge of a twenty thousand dollar wine cellar, is to be pitied if he feels obliged to consume all the palate-tempting compounds which these officials set before him, and which must inevitably in themselves induce a chronic indigestion, that will destroy all capacity for the enjoyment of everything in life. That this is a true state of affairs is proved by the fact that some of our multi-millionaires do not themselves indulge in rich dishes, but wisely choose a digestible and wholesome diet. "I let my friends get what enjoyment they can at my table from the creations of my chef, but for my own part, I find such things do not agree with me and I do not touch them," was the very philosophical though hardly Christian remark once heard by the writer. This discussion is con-

ducted with a view to ascertaining just what constitutes a compatible and wholesome, yet palatable diet. Experience leads to the belief that many people are suffering from impaired health due to an excessive use of free acids or acid-generating food and drink unknown to themselves, or to their medical advisers, simply from a want of accurate knowledge on this subject.

Especially is it believed that very many children have their health impaired and are made to suffer for years, if not for life, as the result of the improper use of acids and sub-acid fruits (and the acid-making foods, sweets, candy and so forth), simply because of the prevailing opinion that fruits are so nourishing for children; and this doctrine it is painful to say, is promulgated by most of our books on diet. If there is any one principle which we regard of great importance, it is that children should have all food containing free acid and all acid-making substances strictly eliminated from their diet, requiring, as children do, so much earthy matter to form their bony frame and for this purpose needing blood of continuously maintained alkalinity.

It is with great pleasure and most hearty commendation that the writer quotes here the following words of M. Verneuil, spoken recently before the French Academy of Medicine: "The practice has been to stuff pale, anæmic children with tonics of all sorts, but this treatment, by predisposing to congestion, is diametrically the oppo-

site of the treatment required by these patients. That which is first of all necessary in these cases is the alkalies and a vegetable régime."

Any physician of experience will testify that he has seen more convulsions from intestinal irritation and indigestion caused by eating fruit, than from any other one article of diet. Parents or nurses can scarcely be blamed, however, for indulging children in such diet, especially when they cry for it, since in a late manual on "The Care and Feeding of Children," the following advice is found: "Oranges, prune pulp and baked apples may be allowed a child after the fifteenth month,and a child two and a half years old may have apples, grapes, pears, berries, etc. Fruits are an important part of a child's diet because they help digestion, and keep the bowels regular." Such statements do great harm. Every cemetery in the land contains many little monuments on which the inscription should be, "Killed by eating fruits under the erroneous opinion that they formed a necessary part of infant diet." If the writer speaks somewhat warmly on this subject, he does so because he believes it to be his duty to protest against all such advice as that just quoted. He may be pardoned for feeling that he has earned the right to speak with authority, because his belief is the result of what he has seen and learned in a thirty years' experience in active practice, and he submits that the only safe rule is to forbid all fruits to children

until they have at least ten teeth, and then to allow them only the banana and date in moderate quantities.

Here is a quotation from an 1894 book on food, issued in England, which illustrates the point under consideration. "All fruits lower the temperature of the body in summer, decreasing the process of oxidation and thereby preventing the waste of the system; activity is increased and fatigue and thirst are diminished. This is the general action of all fruits when used as food and especially is this true of the following: pears, pineapple, grapes, cherries, gooseberries, apricots, oranges, peaches, currants, plums, nectarines, bananas, melons, etc. All are rich in acids, vegetable jelly and saline matters, and produce a cooling and purifying effect on the blood, regulate the bowels and refresh the whole system." Why fruits do not lessen the temperature in winter as well as summer the suffering world is not told, neither is the amount of free acid and vegetable jelly in the banana or melon given, nor are we informed how gooseberries increase activity and diminish fatigue, nor is the purifying effect on the blood of a diet of currants made plain to us. Still, just such opinions as this of the action of acid fruits on the system generally prevail; hence it is high time that some accurate knowledge should take the place of these fine sounding popular fallacies.

It is a well established fact that persons ad-

dicted to stimulants or narcotics, such as whiskey, beer, wine, tobacco, etc., are very slow to admit that any general derangement of their health may be due to the use of these things which they crave. So, in the matter of the excessive use of acids in food and drink the writer knows it will be very difficult to convince any one addicted to their use of the injurious effects of sour substances on the animal economy, especially if the person's physician is given to the same violation of dietetic law.

We have now gone far enough in our discussion to be able to propound some conclusions and these must, it seems, be so plain that "he who runs may read."

Digestion is an alkaline process and man may be called a piece of mechanism run by a battery which is excited to activity only by a certain definitely alkaline fluid, the blood; anything which tends to reduce the alkalinity of this fluid deranges, in just that degree, the normal working of the mechanism.

Acids, therefore, being opposed to alkalies, are contra-indicated as entering into any material that enters into the composition of the blood. This remark applies to both acids taken into the body from without and those generated in the body by fermentation.

CHAPTER V.

DRINKS, HARMLESS AND HARMFUL.

In previous chapters acid has been discussed as an element of food, and attention has been called to acid-making foods. The logical continuation of the subject now leads to the consideration of acid as taken in drink, including, necessarily, those drinks which generate acid in the alimentary tract, as well as those acid in themselves. In the first chapter thirst was discussed, and reasons given for not classing water as a food, as most writers do. Reference was also made to the injurious effects of various germs when taken with food or drink, and it was shown further that micro-organisms have no useful or necessary office in the digestive tract. The remarks there made should be read again in connection with the present subject, in order to make clear and prevent any misunderstanding of what is to follow. It is especially desired that one fact, already mentioned, be steadily borne in mind; that is, the double office water fulfills in the animal economy, by acting either as an acid or as a base; for primarily digestion is essentially a process of hydration, and assimilation a process of de-hydration.

The human body contains about 73 per cent of water, and the average man requires from 48 to 64 ounces of that liquid per day to maintain the vital processes in health, besides what is taken into the system as an ingredient of the food consumed, amounting to about 25 ounces more. All this water, be it noted, is eliminated from the body unchanged; it is still water, as far as its chemical composition is concerned. It is carried out of the system by the following channels, and in about these amounts: 50 per cent by the kidneys, 28 per cent by the skin, 20 per cent by the lungs, 2 per cent by the fæces. Water is the medium by which the life-sustaining, tissue-making material is carried to the various parts of the body; it is also the medium in which alone the osmotic processes connected with cell life can go on; and besides this, it carries with it from the body the waste materials resulting from the life changes taking place in the tissue cells. Unlike food, of which there are many kinds and which admits of substitution, one variety for another, water stands alone. There is nothing like it and nothing can take its place.

Without stopping to refer to the two grand divisions, as found on the earth, of fresh and salt water, we mark that there are two sources of supply for the kinds we shall consider.

First, that furnished by nature in the form of rain from the clouds, called soft water. This is distilled water, though by passing through our

atmosphere it may become contaminated by the impurities suspended therein; but after a shower has continued for a time, the atmosphere being washed, as it were, the water, if then collected in the open country, will be found to be perfectly pure. As rain water is collected and stored in cisterns for use, it must be taken into account that by falling on roofs and passing through gutters it is subjected to a process directly opposite to that of filtration, in that in passing over extensive dirty and germ-covered surfaces, it is made to take up every form of impurity from them, in which there is sure to be a large percentage of organic matter. This liquid is then collected into a receptacle, often a wooden tank, sometimes of cement, but almost invariably placed below the surface of the ground and tightly covered, and quite generally under the kitchen floor. Sooner or later, fermentation takes place, and the average rain water, as found through the country, in villages and on farms, is a brown, ill-smelling liquid, the use of which for any purpose, except as a fertilizer, is not to be recommended.

The second source of water is found in springs or wells and in rivers or lakes. All these hold in solution varying amounts of the common mineral salts of the earth, lime, magnesia, potash, and soda. Water of this kind is distinctively known as hard water; and it is an important fact, that water coming from the earth or found in the

earth is always hard water, for there are no soft water springs.

In some volcanic regions, or places in which the soil has extensive alkaline deposits, or where water comes deep from the bowels of the earth, pouring forth in the form of hot or cold springs, it may be so saturated with alkalies as to be positively poisonous. This condition exists in the bad lands of Dakota and in many springs of the Yellowstone Park. Other springs, both hot and cold, like the hot springs of Arkansas or other well known medicinal springs, existing almost in every state, contain various substances in such proportions that the water may be considered curative, or remedial for diseased conditions. Water of this kind is known as mineral water. It is undoubtedly true, however, that the cures effected at mineral springs are largely contributed to by care in dieting and the enforcement of hygienic rules, as well as by specific virtues in the water.

It is also to be remembered that the water of medicinal springs is invariably alkaline, in many of them strongly so. The plan of treatment at these places, besides using the water, includes abstinence from acid and acid-making food and drink. It is worthy of note that there is no acid mineral water used for curative purposes at mineral springs. The most brilliant results are achieved by a course of alkaline mineral water, combined with proper diet. Mineral springs

must be conceded as among our most valuable agents for the treatment of disease. In Europe the value of a course of treatment by alkaline waters combined with proper diet has been recognized by the medical profession for years. Many of the foreign springs have a world-wide reputation, but fortunately Europe has no monopoly in this regard. In our own country are found numerous springs equal, and in many cases, superior to those abroad.

The consideration of distilled water naturally follows here, it being extensively used under special circumstances, as in the case of vessels at sea. This affords their only method of procuring a plentiful supply of pure water. Besides removing all solid matters, distillation deprives the water of the air and gases in it; therefore it has a flat and insipid taste, frequently somewhat metallic. Distilled water, can, however, be easily aerated, which removes this objection.

Experiments have been made showing that the prolonged use of distilled water has a tendency to interfere with nature's normal processes. It is an important fact that protoplasm of all kinds is killed by immersion in distilled water, proving that to prevent the essential salts in cells being removed by diffusion, the water surrounding them should contain a certain amount of saline matters. When we use, therefore, the term pure or wholesome water, we mean:

FIRST.—That it should be free from micro-

organisms; in other words, that it should be a sterile water. On this point all hygienists and sanitary authorities agree.

SECOND.—That it should contain an amount of natural saline substances which may vary within very wide limits, say from twelve to forty-eight grains per gallon, which is the average in spring, lake and well water. Such water should also contain from 20 to 30 per cent of its volume of air in solution, and a certain amount of carbon dioxide.

How many cases of ill health, disease and death may have been caused by drinking unwholesome water, we have no positive means of knowing, but we do know of many instances of outbreaks of typhoid fever, diarrhœa and dysentery, which have been directly traceable to drinking water containing the disease-making germs. If, then, it is of such vital importance to health that the water we drink should be free from germs, as is universally admitted, it must be equally important that germs be eliminated from our food. Water being more likely to receive germs by reason of the ease with which the source of supply may be contaminated by sewage and filth of various kinds, and being uncooked, merely requires greater care to preserve its purity. The assertion that both food and water should properly be free from micro-organisms cannot be consistently or successfully disputed.

The methods by which drinking water can be rendered sterile are of great importance and merit careful consideration. It is conceded that this must be a matter of domestic concern, as no system has yet been devised by which the public supply of water can be furnished to consumers germ free. We must adopt methods which can be readily used in each household, and either boiling or filtering will answer the purpose.

Boiling the water kills the germs, but it also expels the air from the water. This objection can be overcome by churning or beating air again into the water before using it. Some of the earthy salts are also removed, notably the carbonates, but not to a harmful extent. The sterilization of water by boiling is a most thorough method, and a true germ-destroying process. No special apparatus is required; all that is necessary is a fire and a kettle. It is therefore universally available, and is to be highly recommended in all cases where the water is open to the suspicion of being germ-laden.

The filtering of water to rid it of its impurities is simply a process of straining, and as strainers may have coarse or fine interstices, certain substances used as filters are often so porous as to admit the passage of minute disease-breeding micro-organisms. All filters, it is to be noted, are simply filth and germ catchers and retainers, not destroyers, and may therefore even become an element of danger by permitting, at times,

the escape of an immense number of collected germs into a given portion of water, which from having passed through the filter might be supposed to be free from injurious organic matter. A true filter, then, must of necessity be of such form and structure that the filtering medium, while impervious to the most minute organisms, may be removed from time to time and easily cleaned and sterilized.

Pasteur, in his experiments with liquids containing germs, required some method of filtering them out of these liquids without destroying them. All existing devices he found faulty, but upon trying unglazed porcelain as a filtering medium, he found it, when properly made, perfectly impervious to the most microscopic germs. This valuable discovery has now been put to practical use in devising a simple filter for domestic use, which can be readily cleaned and sterilized as needed; such a filter, when used with these precautions, is, as results show, germ proof. From the shape of the tubes used in this filter, they are known as candle filters. In their original form these filters were limited to use only on water under pressure or head, but happily this objection has now been overcome and a filter constructed in which a number of tubes are employed coupled together and with a siphon attachment, making it possible to filter water from one vessel to another at the rate of one to two pints per hour. The sterilizing of

the tubes is best effected by subjecting them to a bread-baking heat for an hour's duration; practically it is convenient to have two sets of tubes which may be used alternately. This filter acts equally well on either hot or cold water.

Sterile water may be badly infected by the use of impure ice allowed to melt in it for cooling purposes. It was formerly believed that freezing destroyed microbes, but this is not found to be true, and hence the clearest and most sparkling cake of ice may be the crystal prison of a myriad of hibernating micro-organisms, only waiting to be released to begin their destructive work. The difficulty of knowing just where our supply of ice comes from, and the temptation of the dealer in times of great demand, to substitute what he calls "butcher ice" for his "family ice" forces us to adopt the only safe rule under the circumstances; that is, always to cool our sterile drinking water by contact of the retaining vessel with the ice, rather than by the immersion of the ice in the water. Artificial ice is made of distilled water and is therefore sterile. With this exception, be it borne in mind, the putting of ice in drinking water is always an unsanitary and dangerous method of cooling it and should never be done.

A few general considerations regarding water are now in order. As a rule, people probably do not drink enough water. Thirst, nature's call for fluid, is not answered, oftentimes because of the

inconvenience or impossibility of procuring a supply of water, the purity of which is certain. This remark applies particularly to dwellers in large cities. An ample supply of wholesome drinking water should be attainable in every building and household. There is probably nothing which would be more beneficial to the masses than the contriving of some plan by which every street corner in our cities could be provided with pure drinking water, and some way of enabling the people to drink the water without using a common cup. It would, no doubt, do much toward advancing the cause of temperance. Infants and young children frequently suffer, especially in warm weather, from a want of water, not being able to make their want known. A plentiful supply of water taken into the system is an absolute necessity for the literal washing out of waste materials from the blood.

Professor Etheridge, in discussing medical gynecology, says, "Cold water, drunk in quantities in the evening, will dissolve and flush blood impurities, which, producing cerebral irritation by their frictional contact in their passage through the capillaries, thus causing insomnia and nervousness, now find their way out of the body through the kidneys." Certain it is that water is nature's diuretic. The loudly heralded diuretic properties of various mineral springs are chiefly due to the fact that water is drunk there in large quantities. Any physician can recall instances in which febrile

action has been induced in infants simply for the want of water. Infants should be given water to drink freely (not too cold, however), as milk alone does not furnish enough water for the system. It is a popular belief that water is fattening, and the reason is easily understood, for it is, as we have shown, the medium for conveying material to the different parts of the body, and for removing the waste products therefrom, hence, naturally, those drinking most water must have the supply of nutritive material best distributed throughout their bodies and the waste products most quickly eliminated.

The question of drinking water while taking food at meals is often raised, many saying that it should not be done, assigning as a reason that it dilutes the gastric juice. Experiments made show that this is an error, and that the digestion of ordinarily dry substances such as bread and meat is hastened from half an hour to one hour by being thoroughly moistened in the stomach, say to the extent of a glassful of water while eating. The dryness of the food must be a guide in this matter, as this will naturally cause the sensation of thirst, and we may safely respond to nature's demands, and, if thirsty while eating, drink water until the sensation is overcome. The water is no doubt largely absorbed directly by the stomach and taken at once into the blood, thus aiding secretion.

The temperature of drinking water may vary

from icy coldness to almost scalding heat, and may be taken in either of these conditions in proper amounts, without any injurious effects to the stomach. The ingestion of an excessive amount of ice water at one time may, by rapidly lowering the temperature of the body, in certain conditions, induce a chill or congestion, but in that case the harm is caused rather by the amount of cold liquid taken than by the degree of cold. Very hot water in many cases quenches thirst better than cold water. It acts frequently as a gentle stimulant to digestion and is a drink to be recommended to many. In catarrhal conditions of the stomach the drinking of hot water is attended with the happiest results. It accomplishes all that lavage does in a simpler manner, and without using the stomach tube. A cup of very hot water taken on retiring will frequently induce a refreshing sleep in cases of insomnia.

The bottled effervescing waters are very wholesome and in many cases are useful aids to digestion. What is known as "white pop" and the plain soda from fountains come under this same head. Soda water as drunk, with a large admixture of so-called fruit syrups, is objectionable because, as their composition is uncertain and generally sophisticated, they are likely to induce fermentation in the stomach. Effervescing water combined with ginger and known as ginger ale, if genuine and of honest materials and combination,

is gently warming and mildly stimulating, and its use is harmless and in many cases very acceptable to the stomach.

The so-called cherry phosphate, acid phosphate and lemonade, and in fact all acid drinks, are objectionable by reason of the acid they contain, the deleterious effect of which has already been fully shown.

There is a kind of drink known as root beer which cannot be too strongly condemned. It usually consists of four or five ounces of wintergreen-flavored vegetable extract, added to a number of gallons of water with a large quantity of sugar and half a cake of yeast, the whole being allowed to take on active fermentation for a few days, when it is bottled, and ready for use. The fermentation is in no way restricted by any ingredient in the mixture, and the amount of sugar added to the vegetable matter in the bottle of root beer extract makes the whole simply a flavored yeast, which is entirely unfit for use as a beverage. Its effects are to derange digestion and to set up bacterial action in the alimentary tract, which is likely to cause inconvenience, if nothing worse. The writer has been called upon many times every season of its use to treat obscure digestive derangements, or bilious conditions, both in children and adults, all of which were directly traceable to the drinking of this acid-making, germ-breeding mixture called root beer. The very fact that it is generally considered

harmless makes its being the cause of intestinal derangements likely to be overlooked.

We have said that the objection to using root beer is the introduction into the alimentary tract of a quantity of yeast. This needs explaining. Yeast, when mentioned, is generally understood to be a particular kind of ferment, harmless to the animal economy and useful in bread or beer making. Yeasts were formerly grouped simply under two heads — the alcohol making and the non-alcohol making, but this is not sufficient for the present purpose. It were better to say that there are harmless yeasts and injurious yeasts, which is simply another way of saying that there are harmless and injurious micro-organisms. For the term yeast is the common name for those specially prepared cultures of micro-organisms used in bread making, brewing, etc. In the case of wine making, however, no yeast is added, but the fermentation is induced by the various microbes which find their lodgment on the skin and stems of the fruit, and which may be called natural ferments, so the special flavor of the wine made in certain vineyards is due to a peculiar fermentation of some specific microbe, making its home in that vineyard, and it is not to be attributed to the soil, climate, or variety of grape.

Experiments lately made have proven this, for by adding to the sterile juice of the same variety of grape grown in the same vineyard, pure cultures of different yeasts, wines of specifically

different flavors have been produced. In fact, by those engaged in wine making, brewing, or distilling, there is what is technically known as "wild yeast," meaning that some harm-breeding microbe has found lodgment in their material and so damaged their products. So important is this matter, only lately recognized, that breweries and distilleries have competent bacteriologists in their employ, whose duty it is to attend to the cultivation of their yeasts, that is, they take care to breed only the peculiar fermenting microbe they require. The trouble is just here. If we take a portion of baker's or brewer's pure yeast, and add it to a liquid or substance to be fermented, it does not necessarily follow that the particular kind of harmless microbe we introduce will be the only kind reproduced. On the contrary, experiments show that in varying conditions many different kinds of microbes and bacteria may come into life. We have, of course, no means of separating these different kinds or of maintaining what is known as a pure culture. Schutzenberger says, "Nothing resembles putrid fermentation with reference to the derived products more nearly than the change which takes place in the constituent parts of yeast, when left to itself." So, it is plain, that in the case of home-made fermenting root beer, or of any substance which may take on fermentation, in the stomach, we cannot be certain whether we have a harmless or an injurious germ, for the number of fermentive

and putrefactive microbes is endless, and whether one or the other kind predominates in any substance is not easily determined. This remark applies with equal force to all forms of food and drink in which fermentation is easily induced, and to these reference will be made hereafter.

Second only to water in its importance as a germ-breeding, disease-conveying medium, is cow's milk. In discussing this liquid, we are met at the outset by the question of its being infected by the bacillus of a disease with which the animal, from which the milk is taken, may be affected. This is the bacillus of tuberculosis. Some veterinarians claim that as high as 20 per cent of all cows are infected with disease, and that no herd can be found free from diseased animals. A large consumption of milk and a high death rate, from tuberculosis, of those drinking it, as shown by statistics of large cities, may not stand in the relation of cause and effect, but the importance of accurately settling this question cannot be denied. In China, where cows are almost unknown, the death rate from tuberculosis is low, and yet the general conditions are favorable for this disease. Facts like these have led to the raising of the question, "Is not cow's milk, as served to us from uninspected dairy herds, man's poison, rather than nature's perfect food, as it is called?"

In Paris special attention is given to this

point; all cows whose milk is offered for sale there must be proven to be free from tuberculosis by having been tested with tuberculin. In using this test, observations prove that if the animal shows a rise of temperature after the injection of this substance, tuberculosis is always found present.

In discussing the prevalence of tuberculosis in milch cows, reference is made to the report of the Board of Cattle Commissioners of Massachusetts of 1894, which gives the following table of the percentage of tuberculous animals from abattoir statistics:

Prussia	8.3 per cent.
Dresden	14.4 per cent.
Upper Silesia	9.5 per cent.
Yorkshire	22.0 per cent.
London	25.0 per cent.
Berlin	12.0 per cent.
Breslau	28.2 per cent.
Midlothian	20.0 per cent.
Durham	18.7 per cent.

Admitting the fact of the ready transmittance of tuberculosis to man by means of milk containing the germs, and accepting the tuberculin test as reliable, the New York City Board of Health has very wisely established (commencing July 31st of this year) a rigid inspection and testing of all cows from which milk is sold. The value of this work is well shown in their first report, showing that milk from thirty-four diseased cows had been distributed to 176 families. This means that 500 persons, at least, were every day

being exposed to the danger of infection from tuberculosis in milk.

Experiments lately made in Germany show the following startling results, which are well worthy of serious consideration. Out of thirty-six cows chosen, the milk or cream of twelve contained tubercle bacilli. Twelve out of eighty-eight guinea pigs inoculated subcutaneously with milk from a tubercular animal, developed tubercle. Of young pigs and calves fed with such milk, five out of twelve of the former, and eight out of twenty-one of the latter, became tuberculous. That infants can acquire tuberculosis from ingested milk containing the germs has been demonstrated many times, and hence the necessity of exercising great care in providing them with germ-free milk.

Leaving the discussion of this particular germ, coming with the milk from the cow, let us contemplate for a moment the fact that a few hours after milking, this fluid has been found to contain from 1,000,000 to 169,000,000 various germs per cubic centimetre. It has been found that the milk from cows fed on green grass sours much more quickly than that from those kept on dry or stall feed. So, too, cows fed on brewers' grains, or distillery swill, or the refuse of glucose or starch factories, give milk unfit for use, it being so badly affected as to have a strong odor and a bad taste, and souring very quickly.

All this is so strongly confirmatory of our re-

marks in a previous chapter, that all microbes in the alimentary tract can but work harm to the animal economy, that its consideration is asked from this standpoint. The dry-fed cow takes a comparatively sterile food, and furnishes the best milk. The cow eating green grass, and all the various microbes on it, has her milk injuriously modified thereby, while the milk from the cow fed on refuse, a diet which may be said to consist chiefly of microbes, is unfit for use. How to get rid of this disease-breeding host, that all milk is so likely to contain, has very wisely occupied the attention of bacteriologists, and we have the satisfaction of knowing that any process that will destroy these germs, introduced from without, will also destroy the bacillus of consumption, which may have come with the milk from the cow. In the thorough sterilization of our milk, then, lies our only safety, so far as can be seen at present.

Mention has been made of the increased danger of the impurities of drinking water as furnished to dwellers in large cities, and the lessened danger of being infected by impure water enjoyed by those living in the country. In the case of infection by milk the danger is common to those using it in the country and in the city, for wherever there is a cow stable, there the air must be germ-laden, and these germs, lodging in the milk, find there a food especially adapted to their growth and multiplication. When it is remem-

bered that all microbes multiply with almost inconceivable rapidity, we can consider no milk exempt from the remarks we have made. So important, indeed, has this matter become that in many large cities milk laboratories have been established, where a perfectly and scientifically sterile product can be procured.

The establishment of a sterilized milk depot by Mr. Strauss in New York city has proven to be a wise and most philanthropic act, as demonstrated by the wonderful lessening of cases of bowel trouble and death among children using it. It is an argument without words, that leaves nothing to be said against the sterilizing of milk. It might properly be called a life-saving station. In fact, then, as far as milk for an infant is concerned, the safest place to procure it, strange as it seems, is in the city provided with one of these disease-preventing laboratories.

As all cannot avail themselves of this privilege, we must consider a domestic method of rendering milk sterile for infants, which can be made available either in the country or in the city, and by all classes. Two methods are recognized, known as sterilization and Pasteurisation. The only difference between these is that sterilized milk is heated to the boiling point, 212° F., for 20 to 30 minutes, while the Pasteurised milk is only heated to 170° to 180° F. for the same length of time. The sterilizing process is theoretically open to the objection of rendering the milk

rather more difficult of digestion; that is, a certain proportion of the caseine and fat are lost to the infant taking it, and therefore, to be fully nourished on sterilized milk, an infant requires more of it than of milk in the natural state. It has also been claimed that the sterilization of milk lessens its anti-scorbutic powers. This, however, is not found to be true. It is to the use of proprietary foods that we must look for the cause of infantile scurvy. It must be conceded that those suffering from digestive derangements, especially infants, sometimes find difficulty in digesting sterilized milk, owing to the slight changes produced in it by boiling. So we may say that sterilized milk, though adapted to those with perfect digestion, may be contra-indicated in some cases having digestive derangements. In view of this, Pasteurisation has been adopted in preparing milk for infants' use of late years, in preference to sterilization, and it is this process that is used in milk laboratories.

The writer has found the following method very successful in the homes of the poor, as well as in those of the rich, and easily employed both by those whose intelligence enables them to comprehend the reasons for its use, and by those who have not the dimmest idea of the end to be attained.

The apparatus required consists of a tall, large sized iron kettle; sixteen round-bottom infant

feeding bottles, those graduated being preferred; one package of fine white cotton; a two-gallon stone butter jar nearly filled with rock salt, which is covered with water; and half a pound of borax, dissolved in two quarts of water in a one-gallon stone jar, in which are kept a dozen black rubber nipples. The iron kettle and one of the bottles must be taken to the tin shop and an order given for a steamer to be made which shall fit tightly into the kettle and sufficiently deep, under its tight cover, to allow room for the standing of the bottles. These must be held upright by being set in a movable rack made for the purpose, which should hold six to eight bottles.

Before sterilizing the milk, it is wise to temper the bottles to prevent their breaking. This is done by tightly wrapping each bottle, after thoroughly cleansing it, in a clean napkin, and then placing all the bottles thus prepared in a clean boiler and covering them with an ample quantity of water, to which salt is added in the proportion of a cup to a gallon. The bottles should rest on some pieces of wood placed in the bottom of the boiler to prevent their coming in contact with the metal, which is likely to crack them. The boiler is tightly covered and the water made to boil, and kept at this temperature for at least an hour, when the whole is allowed to cool slowly for several hours. The bottles can then be removed, well washed and placed in the jar of rock salt and water, care being taken to put a

handful of rock salt in each bottle, which, when shaken, about polishes and cleanses the inside in a most perfect manner.

When ready to sterilize the milk, a bottle is taken from its salt bath and emptied of its salt and water, which is shaken out of it as much as possible, the water adhering to the inside of the bottle being allowed to remain. The proper amount of milk for one feeding of the infant is poured into the bottle from a pitcher (not using a funnel), a moderately tight fitting plug of the cotton is inserted in the neck of the bottle, after the manner of a cork, and the bottle placed in the rack in the steamer. These details are repeated until the rack is full of bottles. The steamer is then covered and placed over the kettle which must be half full of cold water. This is put over the fire and from the time when violent boiling begins, half an hour should be allowed to effect the desired sterilization of the milk. On lifting the rack from the steamer, place it where the bottles can cool as rapidly as possible, in running water if convenient, but not in an ice box. Each bottle of milk when used must be warmed by immersing it in hot water, and the cotton stopper removed only the instant the nipple taken from the borax water is slipped on. The bottles used one day must remain in the salt and water during the next, thus always rotating them.

It will be noticed that no thermometer is used

in this arrangement, and it may be thought that there is no accuracy in the process. This objection is met by the fact that, in practice, the amount of steam generated will effect the thorough sterilization of six or eight bottles of milk at once. The apparatus is inexpensive, easily kept clean, and cannot get out of order, points which cannot be claimed for any sterilizing apparatus on the market. The formula for modified milk, best adapted to the use of infants, belongs to another branch of our subject, for which see Chapter VI.

Buttermilk is a quite popular and extensively used drink, especially in summer. Many have discovered that it causes biliousness, as it is called, in their cases; others find that it agrees well with their digestion. Chemically, buttermilk is simply milk with most of the fat removed and the lactose or sweetening principle converted, more or less completely, into lactic acid by the specific microbe of lactic fermentation. The albuminoids it contains render it quite nourishing. It is a fluid that soon decomposes; therefore, the fresher it is, the fewer microbes it contains, and the more wholesome it will be found. Certain it is that it has no place in the diet of children, nor is it proper for any one with the acid diathesis to drink it, for such persons are made bilious by its use. Those persons who secrete an abnormal amount of hydrochloric acid, however,

may take it without harm, because this acid destroys the microbes in it and prevents their doing harm in the small intestine, while the nourishing albuminoids of the buttermilk are easily digested. It is to be considered on the whole more as a remedial agent, which may be beneficially used in certain forms of illness, and also in some derangements of digestion, than as a drink for healthy people.

This feature of buttermilk illustrates in a very striking manner what has been said concerning wild ferments, for it is likely to contain, besides the comparatively harmless lactic acid ferment, an uncertain number of other microbes, whose ptomaine-making power it is hard to estimate, and it is these that render buttermilk unsuitable as an exclusive diet for any length of time.

Attention may be directed here to koumiss, a Russian preparation made from mare's milk, and in certain localities from the milk of a special breed of mares, whose milk is particularly rich in sugar but poor in caseine and fat. Fermentation is induced in the milk, which is kept in bottles made of skin, by introducing a special ferment, used for that purpose alone, and which gives the koumiss special virtues, care being taken to exclude wild and injurious microbes. In Russia there are sanitaria where koumiss is the principal curative agent used, and the results there attained with the outdoor life

and hygienic surroundings are very satisfactory. What we know as koumiss in this country is made from cow's milk, to which sugar is added and in which both lactic and alcoholic fermentation is induced by brewer's yeast, the carbon dioxide being retained in the liquid by keeping it in tightly corked bottles. That koumiss as made from cow's milk suitably modified has highly nourishing properties is not to be denied. Dr. Charles Dake reports a case of an adult with narrowing of the pylorus (the post mortem showed the opening to be no larger than a knitting needle), where life was sustained for two years on koumiss alone.

The carbon dioxide gas and alcohol in koumiss certainly act as stimulants to the gastric membrane, and the caseine and fat, being in a state of fine subdivision, are easily acted upon by the digestive fluids. It is to be noted that saline matters in milk are not lost by converting it into koumiss, and hence, although koumiss contains lactic acid, the urine is rendered alkaline by its prolonged use, just as it is by a milk diet. If then the urine becomes acid under its use, it should be discontinued as showing that some secondary, abnormal, and deranging fermentation is taking place in the alimentary canal. Lactic acid has marked germicidal properties, and hence may accomplish great good in some conditions by destroying pathogenic and injurious microbes in the alimentary tract.

Dr. J. A. Wesener made, in 1894, a series of tests on the human subject, in which he demonstrated this power of lactic acid to destroy pathogenic microbes in the alimentary tract, when taken in koumiss.

This explains the therapeutic action of lactic acid, which has been used in the bowel diseases of children prevailing in hot weather, which are invariably microbian in their origin. Koumiss of a superior quality can be easily prepared according to the following formula, which the writer has tested repeatedly. Fill clean champagne bottles three-quarters full of fresh, unskimmed, sterile milk; add to each a piece of compressed yeast as large as a bean; stopper the bottles with cotton wool; put in a moderately warm place and shake thoroughly, at least every hour, till a soft fine curd is formed; next add to each bottle two ounces of sugar of milk dissolved in hot water enough to fill the bottle. Cork tightly and wire, shake the bottles thoroughly and keep in a cool place. The older koumiss becomes, the more acid and alcohol it will contain, and this can be taken advantage of in cases requiring its use. Use a champagne tap so the koumiss may be kept from contamination by germs in the air.

When discussing buttermilk, mention was made of certain persons secreting an abnormal amount of gastric juice. A careful examination of the facts will show that this is generally an

acquired or forced condition, brought about by long indulgence in stomach-exciting food or drink. It is, in short, an effort of nature to tolerate and digest substances taken into the stomach in violation of dietetic laws. It is reasonable to assume that a condition of perfect health cannot long be maintained under this unnatural forced secretion. It must be remembered that a person with this extra amount of gastric juice or hyperchlorhydria, is not necessarily a case of acid diathesis. This is marked by an acid condition of the contents of the small intestine, which is strictly an abnormal condition, while a condition of excessive secretion of gastric juice cannot be so termed, as long as it does not reach the extent of acidifying the contents of the small intestine.

Reverting to the drinks considered before taking up the subject of milk, they may be grouped under the heads of plain water and flavored water. The discussion of a class of drinks which may be called water with various stimulating ingredients added to it is next in order. This class naturally begins with tea and coffee. The stimulating ingredient in the former is known as theine, and in the latter as caffeine. These substances, when isolated and used alone, produce the same effect on the system, for their chemical composition is identical. Caffeine enters the circulation and acts directly on the nervous sys-

tem; this much is conceded, and as Professor Virchow of Berlin says, "We have at last arrived at the truth that caffeine (the active principle of tea and coffee) is nothing more or less than a strong stimulant and taken in large quantities a poison, like brandy." Caffeine, be it remarked, however, does not produce those damaging organic changes in the tissues of the body that alcohol does. Notwithstanding, then, that caffeine and theine are identical, the fact still remains that, as these exist in combination with other and differing substances in coffee and tea, and are thus taken into the system, we find their effects are not the same, and we must accept the results of the widespread use of these beverages as our guide, rather than laboratory experiments.

We all know instances of persons who are soothed and made sleepy by drinking tea, while they are stimulated and made wakeful by coffee, and we find in others exactly the opposite effects are produced. Some find that coffee aids their digestion, and others that it inhibits it, and the same is true of tea. Granting, then, that some form of stimulant is necessary for the use of mankind in general; [a matter, however, which we beg to observe is by no means proven to be the case;] and accepting the common experience of the mass of the people of many nations and in different parts of the world, we must admit that tea and coffee are agreeable, refreshing, and comparatively harmless beverages, for those hav-

ing normal digestion. However, this whole subject of the use of stimulants must be viewed from two standpoints.

FIRST.—From that of their effect on health as the result of their continued use.

SECOND.—From that of the feelings of comfort and ease which they induce. This latter point does not enter into the present discussion. Each person would be wise, however, to be quite sure that no ill effects attend these feelings.

To the use of all this class of substances there is one leading objection — the seductive manner in which they lead to excess.

It is certain that for children and young persons, it is far wiser not to begin the use of tea and coffee until their bodies have acquired their growth and are matured. This leads us to consider more specifically the effect of tea and coffee on persons with deranged digestion.

Without going into details, it is here simply stated that careful experiments have been made by competent observers, which prove that plain infusions of tea or coffee resemble acids in their action, by retarding the digestion of both albuminoids and starch, and this inhibiting power is increased or diminished just as the infusion is stronger or weaker.

In a late number of the Zeitschrift Physiologie Chemie, Schultz makes the following report of a series of experiments on the influence of tea and coffee upon digestion:

First.—Under the conditions of the experiment there was 94 per cent of albuminous digestion when neither tea nor coffee was added to the digesting mixture.

Second.—On the addition of tea the amount of digestion was only 66 per cent.

Third.—When coffee was added the amount of digestion was 61 per cent.

It is to the tannic acid in them that we must attribute their injurious effect on digestion. The hot water taken in these drinks has its own special benefits, to which reference has been made, and it may in some cases be difficult to determine to which to attribute the beneficial results, the cup of hot water or the coffee or tea in it. There is, however, generally added to tea or coffee when taken, a substance to which we must call attention, as in our opinion being often the cause of the ill effects on digestion, which is wrongfully attributed to the drinks themselves. This is sugar. It is this added sweetening, in many cases to the amount of two or three teaspoonsful to a small cup of what is simply a vegetable infusion, and which therefore, becomes under favoring conditions, a ready medium for the process of fermentation, which always works harm in the alimentary tract. The intense and peculiarly pungent acid generated by a soured infusion of coffee, no one who has not made the experiment can appreciate.

Since sugar, then, renders tea or coffee much

more prone to fermentation, the propriety is suggested of its omission from tea or coffee, in cases where these drinks seem to disturb digestion. This class of cases, it is thought, will be found to be associated with hyper-acidity, and we must regard sweetened tea or coffee as especially an acid-making mixture, which such persons are wise to refrain from using. It is the part of wisdom to exercise due care in taking into our system foods and liquids which are the favorite breeding media of numberless unknown kinds of microbes which in certain conditions may do us great harm. We desire to minimize the risk to the healthy, and to insist that those persons having the acid diathesis, and all children, will certainly enjoy far better health and strength by heeding the advice not only to use germ-free water and milk, but also to refrain from taking into the stomach any liquid or solid which may contain free acid, or is likely to generate acid through the agency of ferment-causing microbes.

The advice the sharper sold to the mushroom eaters warranted to save them from all harm, may be said to apply to this view of microbes. It was, "Do not eat any and you will not be poisoned."

It is this very subject which has led Dujardin-Beaumetz, Glenard, Bouchard and others, during the past few years, to insist upon the importance of an aseptic dietary in many cases of disorder, especially those of the stomach, liver and kid-

neys. Their investigations have set forth that microbes produce their deleterious effects "By the production of fatty acids and various other irritating substances whereby the alimentary canal is abnormally irritated, resulting in reflex irritation of the solar plexus and other parts of the abdominal sympathetic, as the result of which, reflex disturbances of various sorts, such as palpitation of the heart, spasmodic asthma, neuralgia, headache, migrane, gastric vertigo, coldness of the hands and feet, disturbances of the vision, parasthesias of various sorts, and numerous other symptoms are set up in remote portions of the body." They have also determined that certain forms of fermentation give rise to the formation of ptomaines and other toxic and irritating substances. Professor Dana, of New York, has suggested that degeneration of the spinal cord and other portions of the central nervous system may be the result of the presence in the blood of an excessive amount of toxic substances which have been generated in the alimentary canal by vicious fermentation. These brief statements are sufficient to place in clear light the great importance of antiseptic dietary as a means of both prevention and cure.

The next drink to be considered is made from the cocoa bean. The cocoa bean contains an alkaloid principle almost identical with caffeine, but, in its natural combination with a large

amount of fat and nitrogenous matter, we find none of the physiological effects on the nervous system produced by caffeine. Cocoa properly must be regarded as a food substance rather than a stimulant. The fat in cocoa known as cocoa butter has a remarkable quality, possessed by no other organic fat, that it does not become rancid or sour.

The cocoa bean appears upon the market in three forms, known as plain chocolates, sweet chocolates, and cocoas. In the plain chocolates all the fat is retained, and no sugar is added. In the sweet chocolates about half the fat is retained, and about 50 per cent of sugar is added, with vanilla, and in some cases, cinnamon. In the cocoas about one-third of the fat is retained, a comparatively small amount of sugar is added and a considerable amount of starch, either arrow root or wheat flour; the whole being reduced to a fine powder.

It will be noticed that cocoa is less rich than chocolate, and therefore is more easily digested; hence it is the best form for use as a drink by those having a feeble digestion, and is particularly good for growing children. It is highly nourishing, especially when made with milk. The plain chocolate is the most nourishing of all, and may be used as a beverage by those to whom the large amount of fat in it is not objectionable. If free from adulteration, neither chocolate nor cocoa, probably by reason of the peculiar prop-

erty of the cocoa butter, is prone to fermentation in the stomach; and hence they are not acid-making drinks.

Chocolate is a great standby with the French, and often takes the place of meat as well as drink, for French children carry sticks of chocolate to school to eat with bread and butter, just as American children eat ham in a sandwich. The plan is a wise one, and the author wishes to recommend the substitution of chocolate for meat in the lunches of our American children. For a day's tramp or a long run on a wheel, a few cakes of sweet chocolate furnish an easily digested and sustaining form of food.

Among drinks frequently served at buffets and soda fountains is beef tea, made from commercial beef extract. The consideration of this under the head of stimulating drinks may seem out of place, but a moment's thought will make it plain that it is thus properly classified. Beef tea was formerly regarded as possessing great nutritive value, and too frequently, even now, both physicians and nurses think that, if only a sufficient quantity of beef tea can be taken by a patient, his strength is sure to be maintained. Beef tea is now generally made from beef extract, this being an extensive by-product of large cattle killing establishments. It is made from the unsalable bits of meat by extracting this with boiling water or superheated steam. The liquid is then

evaporated to a proper consistency and called beef extract; this, when properly diluted and seasoned, becomes beef tea.

These beef extracts contain chiefly the soluble, inorganic salts of the meat and waste products of muscular cell changes, such as creatinine, xanthine, and hypoxanthine. Chemically, some of these substances extracted are related to the alkaloids, caffeine and theobromine, and have in general simply a stimulating effect upon the system. The insoluble but nutritive fibrin is, of course, entirely absent from beef extract. Recognizing this want of nutritive value in beef extracts, some makers now predigest the fibrin, either with the bromelin of pineapple or with animal pepsin, thus furnishing an extract which, theoretically, contains a large per cent of albuminous matter. Its absolute value as a nourishment it is difficult to estimate; certainly its value is not to be compared to fresh meat juice when this can be obtained. Beef tea, then, is a stimulant and, in certain conditions, no doubt a valuable one, but the very fact that it has in its composition waste animal products renders it very likely to a speedy fermentation of a very objectionable kind, and hence it must be used with great care. Those persons having certain digestive derangements and also those with the acid diathesis are certainly better without it.

The drinks next to be considered are marked

by an ingredient common to all, however much they may differ in appearance and flavor. It must be, then, for the effects produced by this ingredient — alcohol — that these drinks are taken. Such is undoubtedly the case, for it is found impossible to make popular a drink having all the taste and appearance of beer but without alcohol in its composition. An unfermented grape juice cannot be made to take the place of wine for wine bibbers. The two varieties of these drinks are commonly known as distilled liquors and fermented liquors. The alcohol in both of them is of course, the result of the fermentation of saccharine matter by the alcohol-making yeast microbe.

In the case of the distilled liquors, the alcohol is separated for use by distillation from the mash, as the material from which it is made is called. In the case of the fermented liquors the alcohol is not separated from the saccharine liquid known as wort or must, in which it is generated, but the whole is drunk as made, in combination. Alcohol, whisky, brandy and rum, are examples of the first class. In the second class we have beer, ale, and porter, and all fermented malt drinks; also wine, which term includes all the different kinds of fermented fruit juices. All these, of course, contain greatly varying amounts of alcohol.

There is in addition to these two classes of

liquors, a number of drinks known as liqueurs, the bad effects of which are not, as is generally supposed, entirely due to the alcohol they contain, but very largely to added stimulating ingredients. These may best be defined as variously flavored and colored tinctures. The names of those in most general use are absinthe, créme de menthe, chartreuse, angostura, kümmel, anisette, curaçoa, vermuth, etc. The flavors of these different preparations are due to the essential oils distilled or expressed from aromatic plants, with sugar and pleasant flavors added. Many who would refuse to take a glass of liquor might be tempted, under the softened word liqueurs, to drink them. An accurate name for this class of drinks is "poisoned alcohol," as shown in the disastrous results attending their habitual and excessive use, since from their great variety of seductive flavors every drinker can find one agreeable to his taste. Witness the wrecks made by absinthe drinking in France, where it is so popular. It is the common saying there that when the victim of stimulants begins to drink absinthe exclusively, the end is near to hand.

These liqueurs, we say, are poisoned alcohol, though the aromatic herbs used in their preparation, from wormwood to anise and mint and thyme, and so on through the list, are in themselves harmless, and are in general domestic use. But the essential oils distilled or expressed from

these herbs, when taken into the system, even in very small amounts, act as poisons, either irritant or nerve destroying. The alcohol to which they are added dissolves these oils and serves to make them more easily assimilated. Another strange feature of these substances is that a combination of several of them increases their poisonous effects in a manifold degree; therefore the complex composition of many of these liqueurs adds to their harmfulness. From their concentration and strength and the small quantity taken, it is not the alcohol so much as the added ingredients that produce that seductive feeling of exhilaration which masks their poisonous effects.

From what we have said of these substances, then, it is plain that they cannot be regarded from any point of view as proper drinks to introduce into the stomach. A late work on dietetics very truly says, "Liqueurs play no part in invalid diet. They are used as luxuries and are seductive beverages, for their agreeable flavor sometimes begets the habit of alcoholism." It may justly be suggested that the following more correctly expresses the truth: "They are dangerous luxuries, and their agreeable flavor conceals stomach and nerve-destroying poisons, which are far more injurious than the alcohol these liqueurs contain. He who indulges in them does so at his peril."

Closely allied to these liqueurs stands the so-called "Stomach Bitters," "Nerve Tonics"

and "Blood Purifiers" that are sold under the guise of medicines. In nearly every instance it is the alcohol they contain that gives to the user the desired feeling of relief, though the person might from principle decline to use any alcoholic stimulant knowingly. All this class of liquids has been very aptly termed "The Total Abstainer's Tipple." The chemist of the Massachusetts Board of Health has made an analysis of ten of the most popular of this class of patent medicines, and found them to contain from 7.9 to 26.2 per cent of alcohol.

The essential part that alcohol plays in the drinks now referred to makes it necessary to come to some definite understanding as to what change alcohol undergoes in the animal economy, and whether it contributes anything to the growth or renewal of tissue, or the generation of heat or force in the body, and by so doing is entitled to be classed as a true food. The fact that authorities differ so widely on this seemingly simple point, is a strange commentary on our knowledge of the phenomena of digestion and nutrition. Statements like the following, from leading and authoritative works, we assert to be misleading and dangerous, and especially likely to do harm to the young by furnishing them with a license to indulge in drinks they should not touch. One writer says, "Alcohol is a useful food and an agreeable stimulant or a narcotic poison according

to the dose in which it is taken." Another and the latest authority says, "Alcohol as a food adds to the nutrition of the body by its prompt absorption, requiring no preliminary preparation by the digestive organs."

Such opinions can best be characterized as the utterances of the anarchists of dietetics, and like the opinions and recommendations of all anarchists, if acted upon, they are sure to work harm to society. Much of the conflict of opinions as to the effects of alcohol on the system arises from carelessness in assuming that certain favorable effects produced by using alcoholic beverages are due to the alcohol in them, when in reality the other ingredients are the saving elements. Beer, no doubt, contains nourishing substances, and sweet wines, owing to the sugar and saline matters in their composition, may be, in a degree, liquid foods, but the nourishing properties of these drinks manifest themselves in spite of the alcohol in their composition, and not because of its presence. To be accurate then, in our observations, we must consider the effects of the alcohol alone, and not those of the other ingredients in this class of drinks.

Diluted alcohol, when taken into the mouth and stomach, acts first locally, in the same manner as do all pungent aromatic or bitter substances. That is, it causes, as they do, an increased amount of saliva and gastric juice to be secreted; but alcohol, when in an appreciable

quantity in the stomach, has a secondary effect, manifested by precipitating the pepsin in the gastric juice and coagulating the albumen in the food, converting that of animal origin into a particularly hard form for digestion. Now there are a number of substances known as condiments which will effect any necessary increased action of the secreting glands of the mouth and stomach, and which we know are attended by no injurious secondary effects.

The use of alcohol, then, to increase the flow of digestive fluids, is certainly very imprudent and uncalled for, because we cannot regulate the exact amount necessary to do this and not to work harm. Some very interesting experiments have been made by careful observers, on the effect of different dilutions of malt liquors and wines, upon peptic digestion. Dried fibrin and an acidulated pepsin representing gastric juice were used, as a control test. The dilutions used were a 10, 20, 40, and 60 per cent strength of the liquors tested; which were ale, lager beer, hock, claret, and champagne, as representing the mildest forms of alcoholic beverages. The control test showed the normal time for digestion to be represented by 100 units. The fluid containing 10 per cent of champagne — mark the almost entire absence of alcohol in such a medium—was the only one of all the tests which hastened the digestion, its figure being 90, but when the amount of wine was raised to 60

per cent the retarding influence of the same was found to be fixed at 180. Not any of the dilutions with 10 per cent of lager beer, claret or hock, either increased or retarded the action of the digesting fluid. That of ale, however, showed a retarding figure of 115, and its 40 per cent strength raised this to 200, and the 60 per cent strength so checked all action that no record was made. The same results occurred also, by using mixtures containing 60 per cent of lager beer, hock or claret.

The deduction plainly to be drawn from these experiments is that the mildest liquors in any mixture containing more than 15 per cent have a marked inhibiting and delaying effect on peptic digestion, and this effect is increased directly in a ratio corresponding to the alcoholic strength of the dilution. That is, in other words, just in proportion as it contains more or less alcohol. It is important in drawing deductions from these experiments to note that the liquors were very much diluted, a thing not practiced when they are drunk, and that this dilution placed them in the best conditions for developing any beneficial effects they might have on digestion. The failure to show any good results is, therefore, all the more marked and overwhelming, for the advantages were all on the side of the liquors.

It is unnecessary to inquire into the effects of alcohol upon intestinal digestion, because of the

fact that most of the alcohol ingested is converted into an acid in the digestive tract, and hence its good effect can only be expected to make itself apparent in connection with acid digestion. Failing to show any beneficial results here, from what we know of the effects of acid on the intestinal contents, we can positively assert that its presence there can only antagonize and destroy alkaline digestion.

The effects of alcohol on the nervous system can best be appreciated if we assign this substance to its proper place in materia medica, that is with the other well known anæsthetics, chloroform and ether. It is slower in action than either of the other two, but once unconsciousness is produced by it, this state is of longer duration than that produced by the other anæsthetics. Before the discovery of chloroform or ether it was used in surgical operations for its anæsthetic effect. All the nervous phenomena caused by alcohol can be reproduced by either chloroform or ether. The manner in which these substances are introduced into the blood is not essential, for the results are the same if sufficient amounts are given, according to their strength.

Argument must now give way to facts, and we have only to turn to well recognized authorities in experimental therapeutics to determine the mode of action of anæsthetics on the nervous system. It is admitted that alcohol, chloroform and ether act on the cerebral, respiratory,

vaso-motor, and cardiac nerve centers in exactly the same manner, but in direct proportion to the amount taken into the blood. So well is this recognized that Dr. H. C. Wood says in his article on anæsthesia, "I have, myself, no doubt that in not a few cases deaths which have been attributed to ether and other anæsthetics have been in fact, due to the alcohol which has been given to the patient; and it seems to me an unalterable rule of practice that no alcohol should ever be given to the patient suffering from anæsthetic cardiac failure."

The administration of alcohol diminishes nerve sensibility, and the point assumed by many, that alcohol, when taken in varying quantities, has distinctly different effects on the nerve centers, is thus shown to be fallacious. A teaspoonful or a pint taken into the blood produces the same pathological result, namely, one of diminished sensibility, this being directly more or less in proportion to the quantity taken. This may seem at first thought to be inconsistent with common experience, for we know that a weary or exhausted person may take alcohol and feel rested and active. This result is brought about by the anæsthetic effect of the alcohol on the nerve centers which are suffering the sensation of weariness and are calling for rest. The taking of alcohol, however, does not give rest nor restore the waste of any tissue; it merely postpones for a time the vital process of repair, by render-

ing the nerve centers insensible to the demand nature is making. The effect of a certain amount of alcohol is to make a person buoyant, free from care, and with a feeling of exhilaration known as stimulation; practically, however, certain nerve centers which should be wide awake are at this time fast asleep. More alcohol being ingested, more nerve centers become anæsthetized, step by step, a regular order seemingly being followed, for the loss of co-ordination next takes place, shown in the thick speech and unsteady gait. Let more be taken, the brain itself is overwhelmed, unconsciousness supervenes, respiratory, vaso-motor, and cardiac ganglia are paralyzed, and death ensues.

So much for the effect of alcohol on the nervous system. It is evident, then, as effect follows cause, that from this very constant benumbing of nerve sensibility, occasioned to some extent by the daily use of even a small amount of alcohol, there must come its ultimate and permanent effect in the impairment of the vital processes, taking place in the tissues, that is, oxidation, tissue metabolism and excretion, these tissues being directly under the control of nerve influence. The fat and ruddy appearance of the habitual user of alcoholic beverages is very deceiving. His look of robust health, instead of being due to normally balanced tissue, is caused by an accumulation of fat which should have been consumed in the vital processes of the

body, but which nature has failed to do because the alcohol has seized upon, for its own use, much of the oxygen which nature should have employed to utilize the fat. In addition to this we have the benumbing effect of the alcohol on the nerve centers controlling excretion and a resulting failure of the excreting organs. Statistics taken among workers in breweries whose appearance would lead one to remark on their fine physique show that these same men have a very high death rate when attacked by acute diseases.

Coming now to the direct changes which alcohol undergoes in the system, and which bear directly on the topic, it is found that most of the alcohol ingested is converted into acid. All the ill effects of alcohol in the system, however, cannot be attributed to its conversion into acid. Its affinity for oxygen, of which it robs the blood, makes it directly the cause of loading the blood with all those toxic principles resulting from imperfect oxidation in the tissues. What these different substances are chemistry does not inform us. Certain it is by testing the excretions we find nothing which so quickly and in so marked a manner produces that condition of hyper-acidity, with reduced alkalinity of the blood, which we are discussing, as alcohol. Thus clinical experience, which recognizes the importance of forbidding alcoholic beverages to the gouty or the rheumatic, is scientifically confirmed, and the equal importance of withholding its

use, also, in all cases of an acid condition of the excretions, must be admitted. If alcohol is thought to be necessary in fevers or acute diseases, let it be given or withheld, according to the state of the excretions; if these are acid it must be prohibited, as its use can but work harm, while in a hyper-alkaline condition it may be found useful. In using it let alcohol be given in its purer forms, not in the shape of liquids likely to set up a mixed fermentation in the digestive tract, such as beer or wine, the objections to which will be noted later.

From the place properly assigned to alcohol in materia medica it seems almost foolish to take up its discussion as a food. With just as much propriety we might extend our inquiry as to the food value of chloroform and ether. Alcohol when ingested is largely changed to acid in the system; and that acid reduces the alkalinity of the blood, by uniting with the saline matters in it, which are then lost by excretion, has been demonstrated. This being so, those who advocate the food value of alcohol are placed in the absurd position of introducing into the body, and calling it a food, a substance which robs the blood of a part of its vital elements, reduces its alkalinity, and thus creates a disordered condition.

We are next to meet the arguments of those who claim alcohol to be a heat and force producer. In exactly the same manner that chlo-

roform or ether produces heat and force, so alcohol does. The heat experienced by the body on ingesting alcohol is simply due to its local action on the nerve cells in the superficial capillary blood vessels. These are paralyzed by it, and therefore dilate; an influx of warm blood takes place and the surface of the body is warmed, but no heat is added to the general amount produced by the body. In fact, by the drawing of the blood to the surface it is there soon cooled; the true effect of alcohol is thus to reduce the temperature of the body. This well known result was formerly taken advantage of in fevers for the direct cooling effect which alcohol produces. Experience, however, showed that the injurious effects of alcohol, when used for this purpose, more than out-numbered the benefits derived from it as a heat reducer, and its use for this purpose has been wisely given up. If alcohol is a heat producer why is it that Arctic explorers absolutely prohibit its use to their men? Experience has shown that those among them who take it, in even the most moderate quantities, are much more susceptible to cold and succumb to it more quickly than those who abstain.

The production of force by alcohol, like the heat produced by it, is simply the result of its local action on nerve centers. A few whiffs of chloroform may cause an exhibition of strength in a weak patient that a strong man can hardly control, but we do not hear the use of chloro-

form advocated as a force producer. Alcohol acts as a force producer to the person taking it, as a whip does to a horse. The blow adds nothing to the strength of the horse, neither does alcohol to that of the person; both merely cause a rapid expenditure of energy for a time, to be followed, inevitably, by a corresponding period of exhaustion.

We may now consider fermented alcoholic beverages, represented by wine, ale and beer, these including all fermented fruit juices, malt extracts and malt tonics. As was remarked in their description, the alcohol in these drinks is taken with the liquid in which it was generated. In beer and ale and all of this class, this represents a solution of certain nutritious elements extracted from the malt, dextrine, albuminoid substances, etc. In wine and fruit juices there is principally sugar, and very little else that can be called nourishing, as fruits contain so small a percentage of albuminoid matter.

A wine, therefore, may be said to be nourishing just in proportion as it contains sugar, while a beer contains more or less nutritive material according as the wort is stronger or weaker. The claim made by some makers that their fermented malt extract is practically liquid bread is manifestly absurd. Malt liquors are all worked by a cultivated yeast of certain properties, but any fermented liquid, as has been

shown, may, under favorable conditions, take on a wild or injurious fermentation. All that has been said about yeast and fermentation applies directly to all beer and wine. The action of alcohol on the vital processes has been demonstrated, and the bad effects that may accrue, then, from the use of beer or wine, are two-fold: due first to the alcohol, and second to the germs they contain. The large class of sour wines, so extensively used, have, in addition to the above objections another of great importance, that is, the inhibiting effect on digestion of the free acid in them.

Summing the matter up, it would be thus stated: Beer is harmless just as it contains little alcohol, is free from ferment-inducing microbes, is made from pure malt and hops only, and has sufficient time and care given to its preparation. The office of the hop in beer and ale is not altogether for the flavor, as other bitter substances do not serve the same purpose, but the hop has antiseptic properties which retard and control fermentation and thus give the beer keeping qualities. The question of the adulteration of beer, in this country, at least, is one, the importance of which can scarcely be overestimated. Any physician who has had occasion to prescribe an American beer must have been struck with its proneness to cause fermentation and gastric disturbance, while the use of imported beer is not followed by these results.

This is due to the fact that all drinks of this class are rendered ten-fold more injurious by their increased tendency, from being adulterated, to a vicious fermentation. This subject, then, belongs to our topic, and we must call attention to it, because the results following the use of a pure or of a sophisticated article may be very different and must be appreciated. This very fact of adulteration has led our large breweries to put on the market preparations which, it is specified, are pure, and made for the use of invalids, thus virtually confessing that their commercial products are not made entirely from pure hops and malt. The enormous consumption of glucose and powdered rice by brewers is a sufficient commentary on the purity of their goods.

Another telltale fact bearing on this matter is that a few years ago a bill was introduced into congress patterned after those laws in force in European breweries, calling for an inspection and certification of the ingredients used in making beer, which it must be conceded would have been most wise and beneficial. This bill was fought and smothered to death by a lobby, representing all the prominent brewers in this country.

The writer once had a conversation with one of our brewer kings on the subject of the general practice of substituting glucose, rice and some bitter chemical substance for malt and hops in beer, and begged him to send to the writer a bottle of his commercial beer, which on analysis

should prove to contain only the proper ingredients. He promised to do this, and in due time sent a package containing some bottles of his brew especially prepared for invalids' use, and not labelled beer. He evidently did not care to have his commercial beer analyzed. His brew for invalids was not under discussion.

As to sophistication and gross adulteration with substances, many of which are positively poisonous, wine probably stands at the head of the list. The writer has seen a book called the "Wine Dealer's Guide," which would be very instructive and interesting reading to the consumers of these liquids.

For their enlightenment, here are the following three recipes for popular wines. Claret is called for; this is what you are likely to get: "Five gallons of boiled cider, two gallons of spirits, five gallons of water, two ounces of powdered catechu, three or four drops of sulphuric acid to the gallon to suit the taste. Color with tincture of logwood." You wish sherry, and the following may be its composition: "Ten gallons of cider, four ounces of bitter almonds, one gallon of honey, two ounces of mustard. Boil for ten minutes, then add one half pint of spirit of orris root, two ounces of essence of cassia, and three quarts of rum. As this wine is often prepared for sale at auctions, the amount of spirit becomes an important item, owing to its cost; therefore, when this is kept in view, tincture of grains of

paradise should be substituted for the rum." Here is the recipe for port wine, which is so freely used by gentlemen of the old school, who "always get the best." This wine is freely prescribed by physicians: "Twenty gallons of cider, two gallons of honey, two ounces of carbonate of soda, one and one-half gallons of a strong tincture of the grains of paradise, five ounces of powdered catechu. Color with logwood or burnt sugar." In addition to these recipes "published for the trade," there are others for manufacturing seven kinds of brandy, seven kinds of whisky, two kinds of gin, five kinds of rum, ten different kinds of wine, and five kinds of ale and beer. It is a great pity that this book was not published for general circulation.

As to adulteration in other countries, let us quote here the report made by Consul Chancellor at Havre, to the State Department at Washington, upon wine making in France covering the last twenty years. The consul says, "Much of the wine produced has no grape juice in it whatever. The French government recently destroyed 15,000 casks of wine found to contain no grape juice, but made of water, alcohol, sulphate of gypsum, glycerine, salts of potash, and berries for coloring. It has been ascertained that whenever the vintage is poor, immense quantities of sugar, amounting in 1887 to 36,000 tons, have been used for mixing with wine, while the deficit in the production of the vineyards has been made

good by producing many millions of gallons of wine, so-called, from raisins, currants and the lees of the wine press. The sweetness in wine covers many defects impairing its quality, yet many people prefer sweet wines which result in injury to their health."

Since the above was written, an article has appeared in the "British Medical Journal," in which the following statement occurs: "The use of antiseptics as preservatives in beverages is growing, and many adulterations have been tolerated under that pretext. It was lately shown that a British wine contained 26.6 grains of salicylic acid per gallon. We believe that Dr. Corfield in saying that the long-continued use of small doses of this powerful drug may be injurious to health, has on his side the support of medical experience and opinion."

Leaving the question of impurity out of account, it is true of wines as it is of beer, that they are useful just in proportion as they are free from alcohol and acid, and are rich in natural saccharine and albuminous substances. We say in closing, that the question of using any of these drinks in sickness or deranged health, must be determined by the presence or absence of the acid diathesis and the state of the excretions of the person as revealed by the proper tests.

One fact, however, concerning alcoholic beverages, either distilled or fermented, cannot be too firmly impressed on our minds. It is this, that

they stand first on the list of all foods and drinks whose use will induce an acid condition of the excretions, and the attending loss of alkalinity of the blood. This fact alone, from what we know of the harm resulting from the loss of blood alkalinity, should certainly make us very circumspect in their use at all times. In view of these facts, is it not safer to refrain from their use entirely at all times and in all conditions, both in health and in disease?

In closing these remarks on alcohol and alcoholic beverages the writer wishes the reader to bear in mind that nothing has been said concerning their use from a moral or ethical, commercial or political point of view. The matter has been discussed from a purely scientific aspect and expressly in relation to the definite effect of alcohol and alcoholic beverages on the blood.

We cannot close this subject of stimulating drinks without some reference to the kola nut, the latest addition to our list of stimulants. This substance was unknown a few years ago among civilized nations, but travelers brought home accounts of the wonderful powers of endurance manifested by certain savages on their long tramps in the forest, by using the kola nut alone. Our manufacturing pharmacists took the matter up, and from first preparing it as a drug for the use of physicians, they soon enlarged their trade by preparing it for popular use in the form of tablets, and then as a drink known as kola wine,

recommended for use particularly by those undergoing great physical exertion. To those making long runs on the bicycle, this seemed to be the very thing required. A late number of "Notes on New Pharmaceutical Products" has the following on the subject, and it so perfectly covers the topic that we quote from it at length:

"Kola was taken up by the people who would never enslave themselves to rum or opium, because it was announced as a stimulant without reaction. That is the sheerest nonsense. There must be reaction from the exhilaration of any stimulant. The first effect of kola is hardly noticeable. The man who takes it simply feels refreshed, but after eight or ten hours, the heart's action is increased enormously. Then, later, in the habitual kola drinker or eater, there is the lassitude, the nervous weakness and the tremulousness that ensue from over-drinking. The difference is that with kola the reaction comes on more gradually. It is in the insidiousness of the drug that the danger lies. It does away with the fatigue that a long bicycle ride brings; and a tablet, or a nip at a tiny flask, will add greatly to the pleasure of a day's run. Before long the nut comes to be relied upon, and from that stage the development of the slavery is easy. The effect of the kola itself is aggravated by the alcohol which is used in making it into a liquid form. Many a wheelman who would not drink alcohol does not know that in taking kola to fortify him-

self, he is getting "rum" just the same. The important point for the public to bear in mind is, that while kola under some circumstances may be a useful drug, they must not suppose it is harmless, but must regard it with the same suspicion and use it with the same caution as they would opium or morphine."

CHAPTER VI.

FOOD AND ITS EFFECT ON THE ALKALINITY OF THE BLOOD.

Having reached definite conclusions as to the effects of acid and of ferment-making microbes upon digestion and the blood, and having discussed their deleterious effects in drinks, the next step is to consider food from the same standpoint.

Food is ingested for the purpose of furnishing to the body the materials needed for its growth, for the repair of its tissues, and for the generation of heat and force. The body is, broadly speaking, composed of red flesh, fat and bone. The red flesh is in two forms—the solid and the liquid — as found in the muscular structure and in the blood. The composition of these two is so nearly alike that it is fair to designate them respectively as the fixed albumen and the circulating albumen of the body. The fixed albumen of the body is properly so termed because it undergoes comparatively little change in the functional activity of life, whereas the circulating albumen — the blood and its attending fluids, lymph, etc. — is consumed to the estimated extent of 70 per cent in twenty-four hours.

The circulating albumen, besides being the material of which the tissues are made and repaired, is the medium for taking the oxygen from the air in the lungs and carrying it into the tissues, where oxidation is constantly going on. This constant activity, of course, uses up the circulating albumen, and this loss must be made good by a supply taken as food, and life is thus sustained. Theoretically, albumen should be the only food element essential for life, but as a matter of fact, it is found that albumen alone will nourish an animal only for a limited period and in a very incomplete manner. The amount taken must be very large, and it has been found, by experiment, that, with this food, the waste products of the body are in excess of normal; that strength is not well maintained, and that with continued use of it the animal dies with all the indications of starvation. The body may be said to wear out too rapidly. If to a diet of albumen a supply of fat is added, the waste of albumen is at once checked; the amount used being no more than is required for nourishing the tissues; while heat and force are freely generated and strength is maintained, but the fat is consumed in this vital process.

This normal action applies, of course, to conditions of health. In disease the fixed albumen as well as the fat itself is rapidly consumed, and the muscles, as we know, become flabby and wasted.

It is possible to define health, as distinguished from disease, by saying that in a condition of

health the amount of fixed albumen remains constant, while in disease it is consumed. A loss of weight has been asserted, by many writers, to be the test of the equilibrium between health and disease. This, plainly, is not accurate. The question turns on what tissues are being sacrificed to cause the loss of weight. If it is only the fat of the body, its loss may be consistent with the improved health of the individual. An example is found in the prize fighter, who undergoes a loss of weight of one to two pounds a day, and yet is constantly improving in physical health and strength; and one may well note, also, the great care given to his diet in order to accomplish this result. "Overtrained" is a technical term used among athletes when strength and endurance seem to be lessening instead of increasing. Scientifically, it amounts simply to this; the fixed albumen of the body is being consumed instead of the fat.

Those foods which contribute to the formation and supply of the fixed and circulating albumen of the body are known as the albuminates. Chemical analysis shows these substances to be very rich in nitrogen, and of nearly the same composition as albumen itself, hence they are called nitrogenous substances or albuminates. Familiar examples are the white of eggs, the fiber of meat, the white flesh of fish, and the caseine or curd of milk, occurring in the animal kingdom, with gluten and legumin as examples from the

vegetable kingdom. The fat of the body differs in its composition from the albuminates, in that it contains no nitrogen, but has carbon, hydrogen, and oxygen, in definite proportions, and the foods, therefore, which contribute to the formation of fat are known as hydro-carbons. Butter, lard, tallow, and suet are examples from the animal kingdom, while olive oil, cocoa butter, cocoanut oil, and all other oils found in nuts and grains, are familiar types of this food existing in the vegetable kingdom.

It is an important fact that the animal consuming the albuminates and fats makes some of these substances part and parcel of his body unchanged. That is, albumen remains albumen and fat remains fat, from whichsoever kingdom derived. Now, from what has been said as to the loss of weight from the consumption of fat, which takes place in the body of the athlete in training, while his muscles are gaining in size and strength, and from the additional fact that if this exercise is continued after the fat is all consumed, the muscles begin to lose size and strength, it is evident that fat prevents the consumption of the fixed albumen.

Fat as food may then properly be termed albumen-saving food, as well as the heat and force producer. Not inappropriately, the value of fat to the body may be compared to that of the balance wheel to the steam engine. This regulator prevents the machinery from irregular action

or from running away and wearing itself out unnecessarily in its work, and it also augments power. Without fat in our bodies to equalize and hold nature's forces in check, the fixed albumen of our tissue would be consumed and we should become exhausted and quickly worn out. As the balance wheel of the engine stores up power for use when called for, so the surplus fat in the body enables us to respond at once to an excessive or prolonged demand upon our strength, without injury to the body.

Nature emphasizes the importance of always having an adequate supply of this heat and force producing and albumen-saving element available, by associating with the albumen in food a proportion of fat ready formed, or, in its absence, a substance capable of being converted into fat. In the egg the yolk is rich in oil, known as egg oil, while the white is pure albumen. Milk is another example of this combination, the caseine being albuminous while the cream is almost all fat. Meat of all kinds has fat also, freely distributed through it. All these forms of fat and albuminous matter are prone to decomposition.

Strongly illustrating the providence of nature, however, there are vegetable albuminates, as hereinbefore remarked, which are the same in composition and equally good for nourishing the body as the animal albuminates. These are found abundantly in the starchy foods, which keep indefinitely, as is well known, and of which

wheat, oats, rice, beans, peas, and lentils are in common use. These, it is true, are lacking in fat, but the starch in them, which retains its food value indefinitely, is made up of carbon, hydrogen, and oxygen, the same elements found in fat and it is capable of being converted by nature into fat, when required for use in the animal body. Thus it is literally true that albuminous substances in food are always associated with fat ready formed, or with a substance capable of being converted by nature into fat when required. These are known as the carbo-hydrates, and the starch in them never becomes a part of the body tissue until it is changed into fat. In addition to starch, maltose, cane sugar and the sugar of milk are prominent members of this class of foods.

Let us now return to the discussion of fat. It is generally called a rich food, and this is literally true, because as a heat and force producer, according to the amount taken, it stands very high. Many say that it is difficult of digestion. This is not a correct statement of the fact. Fat by itself is as easy of digestion and is as perfectly adapted for nature's use as any form of food, but it must be taken under proper conditions. It is such a concentrated form of heat and force producing material that a free supply of oxygen is indispensable to properly utilize any large amount of it in the body, and therefore it is not, commonly, to be eaten alone as the principal

article of diet. It should be eaten in connection with a large amount of oxygen, inhaled from the air.

A food rich in fat, oxygen, and exercise, should be taken together. Fat may be eaten freely when the atmosphere is cold and consequently rich in oxygen. It may also be eaten by those who, by reason of much exercise in the open air, are consuming a large quantity of oxygen. The almost steady diet of fat pork and beans given the men in a winter lumber camp is just what they require and thrive on; while for a school girl, such a diet could not be commended except when coupled with an amount of physical exercise in the open air which she is not likely to get.

Here, again, the providence of nature is shown, in providing different degrees of concentration of the same form of food and adapting it for use in varying conditions. Force and heat producing food may be graded somewhat in this order. Fat is concentrated maltose, and maltose is concentrated starch. Starch is merely a diluted form of fat, requiring, therefore, less oxygen for its conversion into force and heat; hence it properly enters very largely into the diet of everyday life. Its ultimate utilization by the body is attended by the generation of much less heat than that resulting from the consumption of fat.

Reference has been made to the continuous

consumption of albumen in the body as the result of the never-ceasing motion which is the essential feature of life. The same is true of fat, for a certain amount of it is always being destroyed in the body as the result of the renewal of tissues in addition to what is consumed in the generation of heat and force, and this amount must, of course, be constantly replaced. The formation of fat from starch and its allied substances is one of nature's complicated processes. It is prudent, therefore, when we are eating a starchy food, to associate with it some free fat, and thus butter or cheese is properly eaten with bread, and cream with cereals. By using this combination of free fat with starch we save the digesting and assimilating organs much unnecessary labor, by furnishing to nature fat ready for her daily use, instead of compelling her to manufacture it from the raw materials as required. The expression "ready for use" is an accurate one, for fat is not digested in the strict use of that term. It is split up, emulsified, and freed from extraneous matter, and, without losing its characteristics, is taken directly into the blood as fat, to be oxidized in the lungs and tissues.

The bones of the body, when the animal matter permeating them is removed, are simply fixed mineral substance, differing in no way from inorganic combinations which can be made in the laboratory. This is true also of the saline mat-

ters in the blood and liquid elements of the body. These substances cannot be isolated and given as food alone, as was shown in Chapter I., but will be assimilated and utilized by our bodies only as they exist in their natural state in various forms. Even the salt we add to food is not absorbed by the system, but is eliminated from the body in the urine. Hence, the saline substances demand no separate classification as food.

If albuminoids and fat or starchy food are eaten in proper quantities and combination, and no free acid is taken to neutralize the alkalies in them, it is obvious that the saline matters will also be assimilated in sufficient amount, and this is the point to which present attention is directed. The decreased or increased alkalinity of the blood being determined by the tests heretofore named, it is possible to determine accurately and positively, what food to specify in order to correct any excess or deficiency of the saline matters. So, too, of the other materials of the body. If the fixed albumen is being too rapidly destroyed, or if fat is accumulating in excess, or if the system is lacking in a normal amount of this substance; knowing the office of each of the different kinds of food as here explained, it is possible to point out the proper form to be taken in order to correct the trouble in a rational manner.

It is a well established fact that man may take all his food from the animal kingdom or from the vegetable world with equal well being, if he

adapts his diet to the climate he may be in and to the work he is doing. In looking over the animal kingdom, the shape and arrangement of teeth furnish general indication of the character of food upon which the animal should feed, although it must be remembered that teeth in many animals are designed to perform the same offices as the hands in man, that of seizing and holding, as well as masticating. Looking at man's teeth, it is evident they are a modification of the herbivorous and carnivorous types of dentition, having features found in each. Judged from this fact alone, man is properly an omnivorous animal.

That the teeth, however, are of much value as indicating what the food of an animal should be, is at once disproved when we consider the dental system of the rat. This animal has gone with man to every part of the world, and can subsist, like the carnivora, on a diet of flesh alone, or on grass alone, like the herbivora, while the form of its teeth places it in neither class, but properly in the rodentia. It is, then, the ability of the human system to digest, to assimilate, and to excrete the various forms of vegetable and animal food which nature has distributed all over the habitable world that should be taken into consideration as determining man's proper food rather, than his anatomical peculiarities. In fact, there is no fixed type of digestive organs in single stomach animals.

One very important point must be alluded to here, which does not seem to be generally known or sufficiently appreciated as bearing on this subject. This is that carnivorous animals are endowed with a special power of changing urea in their blood into ammonia and thus freely eliminating it; this tends to neutralize any free acid in the system which would otherwise reduce the alkalinity of the blood. Hofmeister's experiments, on the effect of acids on the blood, quoted in Chapter III., demonstrate this point. Man does not have this ammonia making power, peculiar to the carnivora, and thus it may be claimed that it was not intended he should be strictly a flesh-eating animal. Lacking this form of urea disposition, it follows that his ingestion of urea-producing food should be limited to his power of excretion, and this fact bears very strongly on the point under consideration, showing, as it does, that no natural method is provided man for neutralizing excess of free acid in his system.

Again, the climate must be considered with reference to food, and here again the beneficence of nature is shown, for in the far northern regions where no vegetable food is available, and man's constant diet can be flesh only, (in many cases eaten raw and frozen) the indigenous animals, from which man derives his supply of food, are great storehouses of fat, the kind of food most essential to his existence in those climates. No

vegetable food is found in those frozen regions, and if there were, it would fail to sustain man's life; for explorers from other latitudes are obliged to subsist on the same diet as the natives, largely fat.

In the hot regions of the earth there is vegetable food in profusion, with a number of forms of animal life in the flesh of which there is no excess of fat. In the absence of animal fat, vegetable food, rich in fat, like the cocoanut, is a substitute from which man derives sufficient free fat to supply the daily amount, which, as has been shown, is necessary to sustain the vital process, and which, if nature were compelled to make it entirely from starchy foods, might put too great a strain on man's vital powers, and would be unnecessarily wearing in hot climates where lack of oxygen in the air makes exertion of any kind very exhausting.

Fat and albumen, then, in some shape either animal or vegetable, constitute the two forms of food essential to man's life in the coldest and in the hottest regions of the earth. This fat, be it derived from the animal or vegetable world, has one element — the fat globules or cells — which is identical in both, and it is these globules of fat which nature requires. The other elements of fat, the acid, the glycerine, as well as the cell structure, may vary, and thus some forms of fat are more easily emulsified, or rendered assimilable, than others. Animal fat

undoubtedly is, as a rule, more easily absorbed than vegetable fat. Certain it is that animal fat is more universally distributed and more readily available at all times and in all places than fat in the vegetable kingdom.

In discussing the subject of vegetarianism the question always raised is: Is animal food, in some form, absolutely essential for all races of men? The answer must be unequivocally, no. But confusion will be avoided in further discussions of the question if we keep steadily in mind the physiological truth that albumen and fat are the essential elements of food for man in whatever condition he may be found, and that his life can not be prolonged without them. It is a pertinent and proper question whether we shall derive the albumen and fat from the animal or vegetable kingdom.

On this point vegetarians themselves are divided into classes, from hygienic and from ethical considerations. What are known as vegetarians of the first class, in addition to the vegetable food, partake of butter, eggs, milk, and cheese, which are true animal foods, rich in fat and albumen, but which can be procured without the taking of life. The second, or highest form of ethical vegetarianism, consists in eschewing the use of animal fat and substituting in its place vegetable fat, as olive oil, cocoa butter, etc.

The two classes of vegetarians have at least

two points in common; first, they take no albuminoids in the form of flesh, and second, they both consume fat, the kingdom from which it is derived making no difference in its food value. The question then of determining who shall take the form of food vegetarians deem it best to eat, and in what combinations others prefer to take their food, leaving ethical considerations out of the case, becomes one of age, state of health, diathesis, occupation, education, taste, convenience, surroundings, etc. It may be eminently prudent for many to follow the diet list of vegetarians of the first class; others, perhaps, may find better health by adopting the dietary of vegetarians of the second class, deriving their supply of albuminoids and fat entirely from the vegetable kindom; while others, again, may find they sustain health better by taking their albuminoids and fat in the shape of animal flesh. It is for the masses of the people, whose dietary should perhaps be a combination of all three systems, that these pages are especially written, and, for the guide by which to determine which form of food they should increase, decrease or omit, from the dietary, it is insisted that the test of their excretions and secretions, as to alkalinity or acidity, is the only one worthy of trust.

While considering vegetarianism, it may be both instructive and interesting to study in detail the dietary of a vegetarian of the second class. The lady whose record of diet and work is here

given, is known to the writer. She is not preaching or urging upon others her experiences and views upon diet; she does not raise the ethical question at all, supporting her practice entirely upon hygienic grounds when discussing it with others, but she asserts that her health and strength, together with a general "feeling of comfort in living," are so greatly increased by this dietary that for these considerations alone she would not abandon it.

At the time she began this diet she was not an invalid, any more than is the average person who has minor derangements of health, such as biliousness, headache, excessive weariness, sleeplessness, low spirits, etc. She advises no one to make a radical and sudden change in diet, but in this regard to "make haste slowly." She was many months in reaching the strict diet of the class to which she now belongs; during the six years she has followed it she has had fine health and full strength. It will be noticed that her food, besides eliminating all animal albuminoids and fats, has no salt added to it, above what is in natural combination.

It is commonly believed that salt is added to food to make it sustain life. Books have spread the notion by stating that salt (chloride of sodium) is necessary for animal life. This is literally true, but to this it should be added that nature has supplied the required amount of chloride of sodium in our natural foods in a state

of combination. All that is added to them, in its free state, is not assimilated by our blood, but is thrown off by the kidneys. Some writers on this subject, recognizing these facts, have assumed that free salt is necessary for man's health, because of some vital changes that it causes without being itself utilized. The entire absence of free salt in the dietary appended, and the undoubted health and strength of the person subsisting on it, show that there are no vital reasons for the addition of free salt to our food. It is taken, then, as a condiment, for the purpose of improving the flavor of food. This lady, however, asserts that since she has omitted its use she has acquired a delicacy of taste which enables her to detect agreeable and subtle flavors, even in such simple dishes as the cereals, which she is sure the user of salt cannot appreciate, and hence her diet list is not lacking in the pleasures of the palate. Yeast and all ferments, as far as possible, she endeavors to exclude. The health bread referred to should be made of whole wheat flour and without the addition of either yeast or salt. The bread, however, being prepared at a bakery, it is a question if instructions as to its mode of preparation are carried out, and this is the reason she makes so little use of bread. Could she procure genuine health bread she would use more of it.

With this preface let the lady speak for herself.

"I use no salt in cooking my food, nor on radishes. A loaf of bread, one pound, lasts me five days. I do not like to eat too much of it on account of the salt and yeast it might contain, therefore, I prefer to use more of the plainly cooked cereals. In cooking spinach I put a little cocoanut butter in the pan, and, when it is hot, put in the spinach, out of which I squeeze the water, and let the spinach cook in its own juice. In this way the iron is not thrown away, as is the case when the vegetable is boiled in water, as is generally done. In boiling the cereals I let them absorb all the water they can; some I soak beforehand. The cranberries I simply let boil till they are soft and break, then add enough sugar to make them palatable. At 11:30 a. m. I generally drink about three tablespoonsful of water. I only use cocoanut and nut butter.

On this kind of diet, which never costs me over $5.00 a month, generally less, I feel perfectly well, am less tired at night after more work than in former times, and need less sleep. I get up at 6 a. m. and do not retire until after 11 p. m.

Sundays, I practice on the zither 3 hours altogether at 3 different times. I read and write the rest of the time, when I have no visitors. I generally walk 5 or 6 miles on this day. Mondays I practice 1 hour before breakfast; take a twenty minutes walk before school and the same after it; teach till 6 p. m.; after supper, practice for 2

hours; then study for 1½ hours, generally something in the metaphysical line. Tuesday, 1 hour practice before breakfast; 20 minutes walk; teaching till 6 p. m., with 25 minutes walk in between; in the evening play in the zither club till 10 p. m.

Wednesdays, 1 hour practice before breakfast; 20 minutes walk; teach till 6 p. m., with 25 minutes walk between at 4 o'clock; after supper practice again ½ hour; walk five miles to a meeting; return at 10 p. m.; do a little reading or writing before retiring.

Thursdays, 1 hour practice before breakfast; 20 minutes walk before school; teaching again till 6 p. m.; after supper, practice 2 hours; study for 1½ hours.

Fridays, practice 1 hour before breakfast; walk 20 minutes; teach till 6 p. m., with 25 minutes walk at 4 o'clock; practice 2 hours after supper; read or write for the rest of the evening.

Saturdays, 1 hour practice before breakfast; walk generally 8 miles afterward; sew for 1 hour; study for 2 hours, practice 2 hours; make calls. This is about my weekly routine of work.

OCT. 27TH, SUNDAY.—At 9 a. m., a cup of cocoa, not quite half a pt. of water to a small teaspoonful of Van Houten's cocoa, without milk or sugar, 2 small ripe bananas, ½ lb. of Catawba grapes, a slice of health bread with cocoanut butter. At 2:30 p. m., a sweet potato, about 4 oz., 3 oz of split peas boiled in water with a teaspoonful of cocoanut butter, served with some squares of toasted Graham bread, ½ lb. of Catawba grapes. At 7 p. m., 2 bananas.

OCT. 28TH, MONDAY—At 7:30 a. m., one shredded wheat

biscuit, dry, with 2 tablespoonsful of cranberry jam, a slice of Graham bread with cocoanut butter, ¼ lb. of grapes, 1 banana; nothing to drink because not thirsty. At 11 a. m,. drank ¼ of a tumblerful of water. At 12, noon, about 2 oz. of health bread and nut butter, 1 banana, ½ lb. of grapes. At 6:30 p. m., 2 small baked Irish potatoes with cocoanut butter, 2 oz. of farina mush with cranberry jam, a slice of bread and nut butter and ¼ lb. of grapes.

OCT. 29TH, TUESDAY—7:30 a. m., a dish of wheat flakes, about 2 oz., with cranberry sauce, 1 banana, ¼ lb. of grapes, a slice of bread and nut butter. At 12 noon, health bread 1½ oz., with nut butter, ¼ lb. of grapes and 1 banana. At 6:30 p. m., 1 small sweet potato, 1 Irish potato mashed up with two ounces of split peas, ½ lb. of grapes, a small slice of bread and nut butter.

OCT. 30TH, WEDNESDAY—At 7:30 a. m., 2 oz. of boiled rice with cranberry sauce, ½ lb. of grapes, a slice of brown bread and nut butter. At noon, grapes ½ lb., a piece of health bread. At 6:30, a dish of parsnips, a boiled Irish potato, 3 slices of beetroot, wheat flake pudding about 2 oz., ¼ lb. of grapes, 6 Brazil nuts, a slice of brown bread.

OCT. 31ST, THURSDAY—At 7:30 a. m., 1 shredded wheat biscuit with tomato sauce jam, 1 banana, ¼ lb. of grapes, a slice of brown bread and nut butter. At 12 noon, ¼ lb. of grapes, 1 banana, a piece of health bread. At 6:30, 2 small sweet potatoes, 2 oz. rice pudding with tomato jam, ½ lb. of grapes, 4 Brazil nuts, a slice of brown bread.

NOV. 1ST, FRIDAY—At 7:30 a. m., 2 oz. of boiled tapioca with cranberry jam, ½ lb. of grapes, a slice of bread and nut butter. At 12 noon, ½ lb. of grapes, a slice of health bread, 1 oz. At 6:30 p. m., 1 sweet potato, 2 radishes, 2 oz. of tapioca pudding with tomato jam, 6 Brazil nuts, ¼ lb. of grapes.

NOV. 2D, SATURDAY—At 8 a. m., cornmeal mush, about 2 oz., with tomato jam, one shredded wheat biscuit instead of bread, ½ lb. of grapes. At 2 p. m., a piece of pumpkin pie, a cup of cocoa, 2 bananas, 6 Brazil nuts, a roll. At 7:30, ½ lb. of grapes, a roll.

NOV. 3D, SUNDAY—At 9 a. m., a cup of cocoa, a piece of bread, 2 bananas. At 3 p. m., a sweet potato, 4 oz. lima

beans, 2 oz., boiled, with some cocoanut butter added before serving, a piece of pumpkin pie, ½ lb. of grapes, 6 nuts, a slice of bread. At 7 p. m., 2 small bananas.

NOV. 4TH, MONDAY.—At 7:30 a. m., fried corn mush with golden syrup, 1 banana, ½ lb. of grapes, a slice of health bread. At 12 noon, ½ lb. of grapes, a slice of health bread. At 6:30 p. m., a sweet potato, lima beans 1½ oz., 1 banana, an apple, 6 nuts, a slice of health bread.

NOV. 5TH, TUESDAY—At 7:30 a. m., 2 oz. of wheatall with cranberries, ½ lb. of grapes, a slice of bread and nut butter. At 12 noon, ¼ lb. of grapes, a slice of bread and nut butter. At 6:30 p. m., a sweet potato, 1 oz. lima beans, ¼ lb. of grapes, 6 Brazil nuts, a slice of bread.

NOV. 6TH, WEDNESDAY—At 7:30 a. m., oatmeal mush, 2 oz., with orange marmalade (2 tablespoonfuls of it), ¼ lb. of grapes, bread and nut butter. At 12 noon, health bread, 1 oz., and nut butter, ½ lb. of grapes. At 6:30 p. m., a dish of spinach, wheatall 1½ oz., ½ lb. of grapes, 6 nuts, a slice of bread.

NOV. 7TH, THURSDAY—At 7:30 a. m., 2 oz. of hominy with cranberries and nut butter, ¼ lb. of grapes. At 12 noon, health bread and nut butter, ½ lb. of grapes. At 6:30 p. m., a dish of mashed potatoes, 3 slices of beetroot, 1 oz. of hominy, 1 shredded wheat biscuit soaked in ⅓ pt. of hot water, marmalade, ¼ lb. of grapes, 4 Brazil nuts.

NOV. 8TH, FRIDAY—At 7:30 a. m., Colonial food, 2 .oz, with orange marmalade, a slice of health bread, ½ lb. of Concord grapes. At 12 noon, ¼ lb. of grapes, a slice of bread and nut butter. At 6:15 p. m., a sweet potato, Colonial food, 1 oz., ¼ lb. of grapes, a slice of bread, 4 nuts. At a sociable at 10 p. m., plain cake and a cup of coffee.

NOV. 9TH, SATURDAY—At 8 a. m., gluten flour pancakes with golden syrup, used about 1½ oz. of flour, ½ lb. of grapes, bread and nut butter. At 3 p. m., 1 shredded wheat biscuit, a cup of cocoa, ½ pt. of orange marmalade, ½ lb. of grapes, 6 nuts, bread and nut butter. At 7 p. m., a slice of bread, ¼ lb. of grapes.

NOV. 10TH, SUNDAY—At 9 a. m., gluten pancakes (1 oz. of flour) with orange marmalade, a cup of cocoa, ½ lb. of

grapes. At 3 p. m., 1 sweet potato, a dish of vermicelli, 1 oz., with marmalade, ½ lb. of grapes, 6 nuts, bread and nut butter. At 9 p. m., 1 pear.

Nov. 11th, Monday—At 7:30 a. m., sago, 1 oz., with golden syrup, ½ lb. of grapes, bread and nut butter. At 12 noon, 2 pears, a slice of bread and nut butter. At 6:30 p. m., 1 sweet potato, sago with syrup, ½ lb. of grapes, 6 nuts, a slice of bread.

Nov. 12th, Tuesday—At 7:30 a. m., wheatena, 2 oz., with cranberries, bread and nut butter, ¼ lb. of grapes, 1 banana. At 12 noon, bread and nut butter, 2 pears, 1 banana. At 6:30 p. m., wheatena with syrup, a piece of apple pie, ¼ lb. of grapes, 6 nuts and bread.

Nov. 13th, Wedensday—At 7:30 a. m., wheat flakes, 2 oz., with cranberries, 1 banana, ½ lb. of grapes, a slice of bread and nut butter. At 12 noon, 2 pears, 1 banana, a slice of bread and nut butter. At 6:30 p. m., a sweet potato, 1 oz. of wheat flakes with cranberries, ½ oz. of grapes, 6 nuts, a slice of bread.

Nov. 14th, Thursday—At 7:30 a. m., oatmeal mush with golden syrup, ¼ lb. of grapes, 1 banana, a slice of bread and nut butter. At 12 noon, bread and nut butter, 2 pears, 1 banana. At 6:30 p. m., oatmeal mush with strawberry jam, 4 nuts, ½ lb. of grapes, 1 banana, a slice of bread.

Nov. 15th, Friday—At 7:30 a. m., Colonial food, 1½ oz., with strawberry jam, ¼ lb. of grapes, a slice of bread and nut butter. At 12 noon, a slice of bread and nut butter. At 6:30 p. m., 1 shredded wheat biscuit, ¾ pt. of cocoa, bread and nut butter with strawberry jam.

Nov. 16th, Saturday—At 7:30 a. m., gluten pancakes with golden syrup (about 2 oz. of flour used), ½ pt. of cocoa. At 2 p. m., 1 radish, 1 shredded wheat biscuit, with strawberry jam, 2 small apples. At 7 p. m., 2 sweet potatoes, 1 banana, ½ lb. of Catawba grapes, 4 Brazil nuts, a slice of bread.

Nov. 17th, Sunday—At 9 a. m., gluten pancakes with strawberry jam (1 oz. of flour used), ½ lb. of grapes, 1 banana. At 2 p. m., a dish of spinach, lima beans, 2 oz., ¼ lb. of grapes, 6 nuts, a slice of Graham bread. At 6:30

p. m., bread and nut butter, tomato jam, 3 nuts, 1 banana, a cup of tea (was out for supper, this accounts for tea).

Nov. 18th, Monday—At 7:30 a. m., oatmeal mush with cranberries, ½ lb. of grapes, 1 banana, a slice of bread and nut butter. At 12 noon, bread, 1 orange, 1 banana, 1 radish. At 6:30 p. m., lima beans, 1 oz., mashed potatoes, 1 banana, ¼ lb. of grapes, bread and butter.

Nov. 19th, Tuesday—At 7:30 a. m., hominy, 1 oz. with golden syrup, ½ lb. of grapes, bread and nut butter. At 12 noon, bread, 1 banana, 1 orange. At 6:30 p. m., a sweet potato, hominy, 1 oz., with cranberry sauce, ¼ lb. of grapes.

Nov. 20th, Wednesday—At 7:30 a. m., wheatena, 1½ oz., with cranberries, slice of bread and nut butter, 1 banana, 1 apple. At 12 noon, Graham bread, 1 banana, 1 apple. At 6:30 p. m., a sweet potato, wheatena 1 oz, 1 banana, 1 apple.

Nov. 21st, Thursday—At 7:30 a. m., cornmeal mush, 2 oz., 2 apples, bread and nut butter. At 12 noon, 2 apples, bread and nut butter. At 6:30 p. m., cornmeal mush with cranberries, 2 apples, bread and nut butter (a teaspoonful of the butter), a cup of cocoa, ½ pt.

Nov. 22d, Friday—At 7:30 a. m., tapioca, 1 oz. with strawberry jam, bread and nut butter, 2 apples. At 12 noon, 2 apples with bread. At 6:30 p. m., 2 Irish potatoes with a teaspoonful of nut meal, 2 apples, bread with nut butter.

Nov. 23d, Saturday—At 8 a. m., 1 shredded wheat biscuit soaked in hot water with nut meal, golden syrup, 2 apples. At 2 p. m., tapioca with cranberries, a cup of cocoa, 2 bananas. At 7 p. m., bread and nut butter, 2 bananas."

It will be noticed that bananas, a sweet fruit, were freely used, and that grapes were almost a daily part of each meal, the amount consumed averaging twelve ounces for each day. This is a sub-acid fruit, and the user informs the author that

in using any fruit, she always selects the sweetest varieties. The elimination from her dietary of meat, all yeast-containing and fermenting foods, which are the great acid-making elements of ordinary diet, renders the amount of acid taken, in her case, easily neutralized by the alkaline secretions of the system. That the proper alkalinity of her blood was maintained was shown by the amphoteric condition of her morning urine, demonstrating that the food elements in her dietary were in proper equilibrium.

The small amount of water drunk during a month of this diet, besides the amount taken in the food, is very remarkable and deserves consideration, as it brings out some interesting facts. It shows that by omitting the addition of salt to food and refraining from the use of animal food the sensation of thirst is lost to a great degree, so much so that a diet consisting mainly of bread, succulent vegetables, fruits and cereals cooked in water, furnishes an adequate supply of water for nature's wants. Vegetarians have always claimed that the use of meat causes an abnormal thirst, and that meat-eating and intemperance stand in the relation of cause and effect. Bearing in mind that meat is a stimulant, as we shall show further on, there seem to be some reasons to justify this assertion. It cannot be denied that the vegetable-eating races do not furnish such examples of alcoholic abuse as do the meat-eating races.

This dietary is worthy of a close study, as

demonstrating what has been previously remarked, that a dietary must be tested by actual trial and not by chemical theories or fixed rules, giving so many grammes of proteid, of fat, and of carbohydrates. It is only necessary to keep track of the alkalinity of the blood by testing the excretions, and thus accurately determine, by the waste products of the system, that the food elements are properly balanced. The quantity will be sufficient, if the strength and weight of the individual are maintained.

This principle is also applicable in fixing a dietary for diseased conditions or abnormal states, such as obesity or leanness. The diet to reduce corpulency is conceded to consist of lean meats, and acid fruits, with entire abstinence from fat, starch, and sugar. Such a diet is distinctly acid-producing, and the acid condition interferes with nutrition so that loss of fat occurs, and the benefits accruing are in excess of any injury the acid condition may induce. Still, it is not to be denied that the attempt to reduce corpulency by diet often causes such a feeling of discomfort, by reason of its acid-making elements and interference with natural nutrition, that it is soon abandoned. In the case of leanness, care must be taken to induce and maintain exactly an opposite condition, that is, a hyper-alkalinity, if possible. Hence all acids and acid-making foods, like lean meat and sour fruits, are to be avoided, and plenty of food eaten containing fat, with a generous amount of starch

and sugar; fat-making food such as is found in vegetables which are rich in alkalies.

The school girl's practice of drinking vinegar or sucking lemons to lessen her florid appearance, or to thin her blood, as she says, instances with which every physician is familiar, is physiologically correct, as results show, and is confirmatory of our demonstrations of the injurious effects of an excessive amount of acid on nutrition.

The subject of the value of proprietary or artificially prepared foods is an important one, and in that connection we must note three facts.

The first is, that in the concentration and artificial preparation of food a limit is soon reached, beyond which nature refuses to be normally nourished by however theoretically perfect foods. A dietary cannot be settled by theory alone; it must be proven in practice, and digestibility and the amount assimilated, with the maintenance of physical vigor, must be the test. Nature insists that the different amounts of nutritious matter in food must remain, as to bulk and chemical combination, as they normally exist.

The second fact is that nature must do her own chemical work. It seems that a man cannot make, by chemical action, a food that nature will accept as a substitute for what is made by vital processes. A practical application of this truth is found in the fact that commercial glucose, as made from starch by chemical action, and which

enters so largely into various forms of food, is not a proper and acceptable substitute for the glucose of nature, though it may be chemically identical. The only true glucose for nature's use must be made by vital processes alone, either by digestion in the animal, by germination in the seed, or by secretion in the flower. The products of these processes are called, respectively, glucose, maltose and honey.

The use of glucose in food is urged by those having it to sell, under the specious claim that it is predigested starch. Such juggling with words leads to much mischief. It is not predigested starch, in the slightest degree, as it is not made by digestion. Its proper designation is chemically-converted starch, and as such, it is not a proper food, and its use, either in confectionery or syrups, in canned or preserved goods, in jellies or in any other form, should be prohibited by law. Unfortunately, nature does not rebel suddenly at the introduction of injurious substances like this into the body, and hence the consumer is deceived as to its power for harm, but that continued and excessive use is sure to overtax the functions of the liver and kidneys cannot be successfully denied.

The third important fact is this. The simple removing from food of the water, which it would be supposed could be restored when required, proves to have a deleterious effect on the digestibility of the food thus desiccated. The use of

any kind of dried food cannot be long maintained as a substitute for the fresh and natural form, without injury to health.

These three facts must be kept in mind when we come to consider the food of every day life, for many kinds come under the head of condensed or concentrated, chemical or artificial food, and are therefore open to nature's objection to all this class. The preparation of rations in a condensed form for soldiers' use has received much attention, but the results attained are not as satisfactory as it would seem at first thought they should be, for the reasons hereinbefore given. Elaborate experiments have been made in this direction, by the ablest chemists, under commissions from all the great war powers. It is plain that the nation which could make use of a so-called "iron ration" for its army, rendering it independent of supply trains, and still keep its soldiers in health and strength, would have an enormous advantage in war.

The so-called "pea sausage" made of pea flour and the fat of pork, ready cooked and compressed into sausage casings, was given a thorough test by the German army in the war of 1870 with France. At first it was found to be much relished by the soldiers, but after a few days the men became tired of it, and further use brought on attacks of indigestion and diarrhœa. Science seems to have reached its limit in this regard, for all experiment has led to the con-

clusion that excessively condensed rations will only serve in brief emergencies, and cannot be depended upon for prolonged use. In future wars the utmost effort will, no doubt, be made to furnish the troops with fresh articles of diet in the field. The French government has already, to this end, constructed a number of "bakeries on wheels" for use in campaigns. These are wagons containing ovens and all other necessary appliances, so that fresh bread can be made on the march.

It is conceded that injury may be done to the mucous membrane of the digestive tract by swallowing hard or indigestible substances, or by the forming of coagulating masses in the stomach or bowels, by reason of incompatibility in food, as illustrated by the acid curdling of milk. These effects range all the way from a slight irritation to traumatism, but this feature of the subject is unnecessary of consideration, for it is self-evident that nothing of the kind should be taken into the system, in either health or disease.

No less important than the digestibility of a food is the matter of its proper combination with other foods, as regards the maintenance of a proper alkalinity in the blood. Having ascertained such alkalinity, either by an analysis of the blood or by a testing of the excretions and secretions (it matters not which method is used, so the knowledge is obtained), we have at once a simple and accurate method by which the exact

dietary for each individual case of disease can be determined. That this is the only proper course, any physician who has had experience in ordering the same inflexible dietary for the same disease in all patients will concede. Hence the folly of all printed diet lists for this or that disease, allowing, as they do, no account to be taken of the peculiarities or diathesis or idiosyncrasies of the individual.

As illustrating this point, let us refer again to gout. The proper diet for this disease has been well established by the experience of many men, covering a vast number of cases, and hence can be accepted as substantially correct; but it is found to be far from infallible in practice. Not infrequently medical writers report cases of gout cured by a dietary exactly opposite to that universally approved We must accept, in a general way, the tested and recognized diet for any disease, but the better plan is to analyze the blood, and thus determine whether it is the proper diet for that individual case.

The author has endeavored to demonstrate the effects of certain elements of food on nutrition, but he has no fixed diet list to offer, and no special system to advocate. He simply insists upon permitting the blood of each person to tell what it requires, and this must indicate the proper diet or medication for that individual. The whole art of medicine consists in correctly interpreting the signals nature gives us in physical

signs revealing the cause of the disorder. If we fail to read aright the failure must be due to some fault on our part.

Meat has been characterized as an acid-making food. This may need a word of explanation. Living flesh is alkaline in its reaction, but after death, the flesh of an animal becomes acid, and this, too, in a very short time; and the longer the period after death, the more acid is generated. But it is because of the large quantity of uric acid which may be formed from the great amount of nitrogen in flesh, when ingested, that it is properly called an acid food.

We are told by all writers on food that meat is easy of digestion. Judging merely by the time consumed in its digestion, this may be true, but estimating by the amount of energy required to effect this in a short time, it is plain that it may be very taxing to the digestive organs. The cooking of meat, when properly done, renders it far more digestible than "rare" meat. The heat disintegrates, breaks up and softens the cells and tissues, thus sparing nature this much labor. In the process of cooking, too, some of the stimulating elements are removed, which renders cooked meat less stimulating than rare. Trainers of fighting dogs recognize this and put their brutes on a raw meat diet before their contests.

The albuminates are the tissue-builders, and, taking flesh as the most concentrated form of this

class, it seems logical that it should be the chief diet for infants and children who are building up their bodies. Experience, however, does not prove this to be true, and the very fact that flesh is such a stimulating and concentrated food, makes it a tax on the digestive organs. That is, to digest it may be said to call for a concentration of digestive energy, which, though lasting only for a short time, is weakening to the digestive system, and this very quick digestion necessarily throws into the blood at one time an amount of nutritive material which nature is unable to properly utilize, and which also loads the blood suddenly with waste material which nature cannot eliminate before harm is done.

The colt or calf does not thrive on a diet of rich corn meal, though it may be very proper for the horse or cow. Carnivorous animals, be it noted, do not allow their young to have meat until quite a time after they have all their teeth fully developed, though apparently it would be their proper food. Meat given to kittens or puppies invariably produces convulsions, apparently of the convulsive toxine type. The writer has had the opportunity of admiring the instinct displayed by cats, who will take meat away from their kittens when it is given to them, even up to the time when they are three months old. Comparing cat and man by their age at maturity, this would give us as a rule that children should have no meat when less than five years old.

The wisdom of this plan is endorsed by many of the best authorities on children, especially of France and England, and the author's experience leads him to commend it heartily.

Any physician who has had occasion to observe the course of the ordinary diseases in both those children who have been fed upon meat from infancy, and those from whom it has been withheld until the proper age, must have observed how much more serious were the cases among those of the first class, compared with those of the second, during the same epidemic. The writer has observed another interesting point, namely, that a child fed upon meat from infancy and having that ruddy appearance which calls forth the expression "What a strong, healthy child!" is strangely liable, when maturity is reached, to be found with impaired digestive organs and deficiency of vital force. It seems clear that this is a natural result of a too stimulating diet during childhood, by which the store of vitality is exhausted by the strain thus prematurely put upon it.

We know that the oxygen of the air is essential to life, but it must be properly diluted. To inhale pure oxygen, instead of being conducive to long life, would certainly shorten it, for by its overstimulating effect it would compress into days the changes of growth and decay which nature requires years to work out. All stimulating foods must be viewed in the same light, a proper

amount being desirable, while an increased amount may be injurious. The same reasons for withholding meat from children apply equally to elderly people, with the added danger that their eliminating organs are likely to be losing in power as the result of age, and hence may be the more quickly overcome by any food tending to flood the blood with waste matter.

Here it may be noted that the white meat of poultry and game is less stimulating and has fewer waste products in it than has the dark or red meat of any kind. White meat, then, occupies a position as to properties and ease of digestion, between red flesh and fish. Veal must not be considered as a white meat; it is simply immature beef, and the objection to it is the difficulty of digesting it because of the hardening of the albumen in it by cooking, and therefore the younger the calf, the more difficult is its flesh of digestion.

In speaking of beef tea, it was said to be a stimulating drink. We should also properly class red meat as stimulating food; hence, like all stimulants, there is danger of its over-use, and the danger of acquiring a habit. It is important that its use should be so modified and regulated that just sufficient shall be taken to supply the wear and growth of albuminous tissues, without producing any stimulating effect. This stimulation is caused by the presence in the

blood of noxious material, as it is invariably followed by depression or exhaustion, which is the result of nature's extra labor in eliminating the noxious waste materials.

The fact that eating meat has a tendency to load the blood with acid-making waste matter was strongly illustrated by some tests and observations made by Dr. Joseph Price and Dr. J. H. Kellogg, who, in preparing patients for severe surgical operations, found that those to whom no meat was given, nor meat extract, for several days before the operation, made better recoveries than those who had a meat diet. It is evident that the diet used in favorable cases had the effect of increasing the blood alkalinity instead of reducing it, as meat does, hence the importance of keeping this point in view in surgical cases.

Surgeons who have operated on vegetable-eating Chinamen all testify to the kindly healing process attending the wounds on them. Referring to the observations made by Dr. English, in his article on the "Effects of acid auto-intoxication on the heart," and noting that chloroform or ether, when inhaled for anaesthesia, renders the excretions acid and reduces the blood alkalinity, the question may be fairly raised, is not lessened blood alkalinity one of the factors in death by heart paralysis, which sometimes attends the administration of anaesthetics? Certain it is, that anaesthetics must be administered with

great care to those showing a condition attended with deficient alkalinity of the blood.

Milk has been treated herein as a drink, because of its liquid state, but milk is commonly spoken of as nature's perfect food, and very properly so, for by this is indicated its perfect combination of food elements: viz., albuminoids, fat, carbo-hydrate and saline matter, or in other words, caseine, cream, sugar of milk, and soluble salts. From whatsoever animal obtained, whether the carnivorous or herbivorous, the carbo-hydrate element is found in the form of sugar of milk. It is interesting to note the presence of this element—the starch analogue—in the milk of the carnivora, a class of animals whose diet consists entirely of the albuminous and fat foods, with an entire absence of starchy food.

Milk is normally a typical alkaline food, for the urine is rendered neutral or alkaline through its use as a diet, and the urine of the nursing young of the carnivora and herbivora is the same in reaction. Still, in the face of all these facts, writers can be found who assert that milk renders the urine acid in reaction. This may sometimes be true, but never in normal conditions. The sugar of milk is easily converted into lactic acid by the ever present air-pervading lactic acid germ. In fact, acid and acid-making germs of all kinds coagulate the caseine, as was hereinbefore explained, into what is known as sour curd, which is difficult of diges-

tion, and in which the saline elements of the milk are lost. Thus a double injury is done the milk; first, by the free acid generated, and second, by the loss of the saline elements which it undergoes, as shown when discussing rennin, and thus depriving the blood of just that amount.

The normal digestion of milk affected by rennin produces a sweet curd, in which the sugar of milk remains undecomposed, and the saline elements all remain in an available form for nature's use. It has been claimed that normal milk contains a lactic acid ferment and that the formation of a certain amount of lactic acid was necessary to the proper digestion of milk. This error goes with the accompanying one, that lactic acid is a normal ingredient of gastric juice, both of which theories have been proven to be false.

We can now understand why milk "agrees" in certain cases and "disagrees" in others, for there are three requisites which must be complied with before nature can properly digest or assimilate milk. These are: first, that the milk be sterile; second, that it be modified by arranging a proper proportion of its elements for the digestive requirements of infants or invalids; third, that the alimentary tract be free from acid and acid-making germs, so that sweet curd may be formed instead of sour curd.

The first essential is accomplished by the sterilization or Pasteurization of milk, as has been said. It is, of course, unfortunate that we

are obliged to resort to such methods. With healthy cattle, sanitary stables, aseptic milkers, and conscientious dairymen, it would be possible to have strictly pure milk. Sterilization of milk by heat renders the caseine somewhat difficult of digestion in some cases, and the higher the temperature used in sterilizing, the more this is true; hence the temperature of 170° or 180° (Pasteurization) is preferable to a temperature of 212° (sterilization) for sterilizing milk. The centrifugal cleansing of milk is just now giving very promising results, but its use is as yet comparatively limited, and as between germ-laden raw milk, and milk sterilized by heat, the latter will have to be accepted in the spirit of choosing the less of two evils, until some better method has been devised.

The reason for and the method of securing the second essential for a milk diet, that is, its modification, are as follows:

Cow's milk contains about half the quantity of sugar, twice as much fat and salts, and approximately five times as much curd as human milk. If we dilute it with water, in order to bring the caseine near the proportion existing in human milk, the percentage of fat and sugar is lost. Of course, by a system of accurate weighing and measuring, it would be possible to reach chemical accuracy in the modifying of milk, but this plan is not practicable in the home, where it

must be used. The following details, if carried out with judgment, will be found to succeed most admirably.

The milk chosen should be from a grade cow or cows, Holstein preferably. It is better if it be mixed milk, from two or three animals. The milk of Jerseys or Durhams is too rich, or forced, in its composition, for infants. A sufficient quantity of such milk is placed in a deep cylindrical stone or granitized vessel. This is allowed to stand in a cool, clean place, from three to six hours. The upper third is then dipped off with a small cup and poured into a clean pitcher. This is top milk. Some pure sugar of milk will be required in the original pound packages. Squibb's will always be found reliable. A package of English barley flour is also required: from this, barley water is made, which, after three or four minutes' boiling, should be of the consistency of thin gruel. This liquid is used for diluting the top milk. It is used for this purpose in preference to plain water, because it prevents the formation of hard curd in the stomach. It renders the caseine granular, and, so, easy of digestion.

We give two formulas, one for use at birth of infant, the other for use when the child is eight months old, the proportions of the second being reached by slow gradations from the first, as the child grows older.

FIRST FORMULA.

Top milk	3 ounces.
Barley water	15 ounces.
Milk Sugar	9 heaping teaspoonfuls.

SECOND FORMULA.

Top milk	20 ounces.
Barley water	20 ounces.
Milk sugar	10 heaping teaspoonfuls.

The manner of sterilizing and directions for after management are given in Chapter V. It may be impossible sometimes to procure pure sugar of milk; in such cases pure cane sugar may be substituted, in the proportions of four teaspoonfuls in the first formula and five in the second. Ordinary commercial sugar is not pure cane sugar; rock candy is the only pure available cane sugar. This must be procured in its crystalized form and suitably crushed or ground for use. It must be remembered that this is an expedient, as cane sugar is not the normal element of milk, as sugar of milk is, and therefore is more liable to ferment.

The third essential to the successful using of milk as diet for either the young or the old, either in health or disease, is the absence of free acid or acid-making germs in the alimentary tract.

To this end our principal care should be not to ingest acid or acid substances, such as sour fruits, lemonade, etc., with milk, for these are plainly incompatible. To overcome excessive free acid in the stomach, lime water is very properly combined with milk; this combination per-

mits the formation of sweet curd and its results are very satisfactory. It accomplishes its purpose in preventing the formation of sour curd in the stomach and bowels. The eliminating of acid-making germs from the digestive tract, unfortunately, is not so easily accomplished. In the case of infants thus affected, milk must be entirely withheld for a time, while intestinal antiseptics are being administered to correct this condition. The giving of even sterilized milk in these conditions may be productive of harm.

In diseases like typhoid fever, for instance, when the intestine is known to be swarming with microbes, a milk diet is contra-indicated; in such circumstances, it is certainly an acid-making food, and, though conceding the germicidal power of lactic acid as possibly beneficial, we must consider the harm resulting from the action of many other acids and toxines, which are so readily generated in the milk by microbes. In typhoid fever we find a hyper-acid condition of the secretions and excretions and a reduced alkalinity of the blood, and the correcting of these pathological conditions is the important factor in the successful treatment of this disorder. The benefits which have been claimed from the use of milk in this disease have, no doubt, been due to the fat it contains, for the aid that nature requires in this and other similar diseases is an albumen-saving food to restrain the loss of the fixed albumen, which is being rapidly consumed.

As to there being any digestion or assimilation of nutritive material in cases of high fever, it is extremely doubtful whether the digestive organs are in condition to do any work; hence, the less they are called upon the better. Bouchard has shown that milk taken during fever increases the temperature, and that in these conditions peptone cannot be absorbed, which amounts certainly to a very strong argument against the administration of milk.

Pure sterile cream, unsweetened, properly diluted with barley water, either frozen or unfrozen, becomes the ideal food for this class of cases. It has the maximum of the element nature requires — fat, and the minimum of those which might do harm — caseine, and sugar of milk. Cream separated by the centrifugal method is practically pure and sterile, and is an excellent albumen-saving food in typhoid fever and other diseases marked by rapid emaciation.

An artificial milk, made from sweet almonds, is highly recommended in many cases of febrile diseases or in cases of feeble digestion and assimilation, and often gives better results than natural milk. It is prepared by blanching from one to two ounces of sweet almonds. These are rubbed to a fine paste in a mortar with a little water, more water is added, little by little, until a pint or more is used, according to strength of mixture required, the whole being constantly triturated with pestle in the mortar. When the almond paste and water

are sufficiently incorporated, the whole must be strained through muslin to remove particles. Its appearance, when properly made, can hardly be told from natural milk, it is rich in fat and proteids, and is, therefore, an albumen-saving as well as a nourishing food.

The question arises, Is it wise to give much food in any febrile condition? It is plain that harm can be done by improper kinds and combinations of food, as well as by drugs. Some late and able writers, notably Dr. A. Monae Lesser, of New York, have published statistics of the treatment of fevers without food, antipyretics or alcohol. By giving nothing but water, as referred to in Chapter III., Dr. Lesser's percentage of recovery, under this regimen, was above the average. Why can we not learn a lesson from the brutes, who, when sick, positively refuse food in any form, but take water freely, probably because nature is thus less embarrassed in her efforts toward recovery? By observing the reaction of the secretions and excretions, thus determining the alkalinity of the blood in all febrile conditions, and letting that be our guide, there certainly will be no danger of using improper foods or of overfeeding the patient.

Meat, as was said before, is a concentrated form of food, and cheese may be best described as condensed and purified meat. It has much less water in its composition than meat, and for this

very reason it has, weight for weight, an increased quantity of albuminoid, fatty and saline matters. Cheese, however, differs from meat in that it is made from a substance intended for tissue-building, but is not itself a tissue and hence does not contain waste elements, as meat does. For this reason it is not to be regarded as an acid-making, waste-producing food to so great an extent. Theoretically, it is an admirable form of food, but from its condensation and compactness, it is liable to be difficult of digestion, and, as this is the ultimate test of food, it becomes an important point to be considered.

Cheese is made in so many different forms that some general rules should direct its use. The softer, more granular, and fresher forms of cheese are more easily digested than the hard, old and dry varieties. The skimmed milk cheese should not be considered, as in a true cheese the oil of the cream should be present. Cheese made of cream, or cream cheese, as it is called, is the most easily digested of all varieties; the fat in it separates the albuminous matter. The strong or high flavors in cheese are produced by microbes, and how far these are non-pathogenic and how completely they are destroyed by the gastric juice is an open question; hence it is wiser to refrain from using this form of cheese. Cheese forms almost the staple diet of the English laborer and the Swiss

mountaineer, but they eat bread with it and take no other animal food.

A full meat dinner, involving great strain on the albumen-digesting organs, is ended with a seemingly small bit of cheese; but this, as has been noted, is so concentrated a food that it is difficult of digestion. The digestive powers, already taxed, are not in a condition to attack it properly, and nature, wearied by the labor of disposing of what has been eaten before, simply refuses, or is unable to dispose of the cheese. Hence we understand the force of the common saying that cheese digests everything but itself.

As a true food, cheese should be taken at a meal at which no other animal food is eaten, and a proper amount of vegetable food should be ingested with it. As a relish after a meat dinner, the smaller the piece eaten, the better for the stomach. On account of the tax on the digestive organs attending the eating of cheese, it is evident that it should have no place in the diet of young children. The cooking of cheese with milk renders it more digestible by softening and breaking up the mass of caseine. This explains why a Welsh rarebit, may be classed as an acceptable and easily digested food for some.

Eggs constitute another food which, like milk, is perfect in combination. The white of the egg is pure albumen and, as hereinbefore remarked, is the only single element of food on which life can

be sustained for any length of time. Like milk, it should be taken in its raw state, if we wish to secure its highest nourishing power. Heat, as we well know, coagulates and hardens it, and the higher the temperature and the longer continued, the more indigestible albumen becomes.

The yolk of the egg contains about 30 per cent of fat and is also rich in sulphur; so, if for any cause its digestion is protracted in the stomach or intestines, large quantities of gas are produced, which may cause gastro-enteric disorder. If the eggs are not strictly fresh, this decomposition may take place in the most normal digestion; hence it is of great importance that eggs for eating should be perfectly fresh. Hard-boiled eggs must be considered hard of digestion. An egg, to be properly cooked, should never be subjected to a temperature of over 180°. Omelette and scrambled egg, in preparing which the white is thoroughly beaten with the yolk, are more digestible than when the egg is cooked so that the albumen is formed into a separate hard mass. A diet of eggs produces an alkaline reaction of the urine and hence is altogether one of the most valuable of foods, not being, like milk, liable to microbian infection. Raw egg albumen, beaten in pure water, is a valuable addition to the diet of infants and children.

If cheese may be characterized as concentrated meat, fish may be called diluted meat, possess-

ing, as it does, all the elements of meat in an easily digested and nutritive form. Fish is the only animal which maintains perpetual youth. Its bones are always supple, and its body is continually growing, so that none of the changes of age, loading the tissues with worn out material, as manifested in other animals, affect it. Its flesh always has the tenderness of youth; hence its ease of digestion.

Fish are commonly divided into two classes — those having white flesh, with an absence of marked flavor, and those having red or yellow flesh, which is rich in flavor and fat. The white fleshed fish are the easier of digestion. The meat of all fish having colored flesh is harder of digestion, containing, as it does, so much fatty matter, or fish oil, in its composition; and it must be classed with those rich foods not to be taken by persons having any weakness of digestion.

Fish, as food, has in itself almost everything to recommend it, and is especially good for people of sedentary occupation. Its use is marked by freedom from an excess of waste products in the blood; and a suitable amount, properly cooked, is equally acceptable to young and old. Salt codfish is an easily digested and acid-correcting food, especially beneficial in cases of fermentative dyspepsia. In cases of summer complaint in children, it can often be given with the happiest results, care being taken, however, to procure the genuine codfish. Let it be re-

membered that none of the fish cut into pieces and sold in packages is ever codfish. It is always some other variety of fish, and in many cases the flesh is of quite a different character as to digestibility. To be sure of the genuineness of salt codfish, it would better be always bought whole. What is known as shredded codfish, however, seems to be the genuine article, and is more easily prepared for use; hence it is a convenient form in many cases.

Practically fresh fish is often difficult to procure, but, like an egg, it must be strictly fresh, to be proper food. In this it is in marked contrast to butcher's meat, which becomes easier of digestion by not being eaten too soon after the animal is killed.

The popular belief that fish is a valuable food for those engaged in mental labor, on account of the phosphorus it contains, is not founded on fact. No doubt mental workers have found their efforts easier when eating fish, but it was not due to the phosphorus therein. The true reason for their clearer mental action is to be found in the fact that a fish diet does not load the blood with those waste products which require exercise and a free supply of oxygen to eliminate them from the blood, and these products induce a feeling of somnolency and dullness which is not in keeping with mental activity. The use of fish one day in the week, to enable the blood to unload itself of waste matter resulting from a too free con-

sumption of meat, is a very wise and sanitary practice.

Shell fish, oysters and the like must be classed with the white fleshed fish as food, and the same remarks apply to them all. Crustaceans, lobsters, shrimps, etc., as food, belong with the colored flesh fish, but are even harder of digestion and would better be avoided entirely except by those who live at the seashore and have been accustomed to their use. The occasional use of rich foods like these, by persons unaccustomed to them, is likely to be followed by acute indigestion or symptoms of poisoning which are very distressing.

Among the albuminates or nitrogenous foods is gelatine, a substance that is commonly used, both alone, in the form of various gelatine jellies, and also as an important element in soups made from bones. Although an albuminate, it cannot alone support life and is not a tissue-builder. It is an element of the body, however, and is found largely in the cartilaginous structure of the joints; also in the bones, of which it forms two-thirds by weight. There is also a vegetable gelatine, which is identical in composition and food value with the animal form. Its wide distribution in both kingdoms would indicate that it has an important office to fulfill as a food. Many experiments made to determine its value warrant us in accepting these facts. Gelatine is not a life-sup-

porting food, but, like fat, when mixed with other food it aids nutrition and is itself easily digested and absorbed by those having feeble digestion.

In fact, there is good reason for supposing that it increases the secretion of gastric juice in some way unknown to us, and further, like fat, is an albumen-saver, being of decided value in reducing the waste of albumen tissues. Carefully prepared gelatine jellies or gelatine-made liquid, pleasantly flavored and used as a drink, may therefore be used with advantage in febrile states, where the checking of the waste of the fixed albumen is the point to be attained. Pure gelatine is not an acid-making food and, therefore, is not contra-indicated in cases of acid diathesis.

Soups are made with stock or without stock as a basis; this means that they have or have not the soluble elements of meat and bone in them. All soups in which the stock is made from meat alone are simply, as far as their place in diet is concerned, meat extracts, and all rules as to their proper and improper use are the same as already given for the use of meats and meat extracts. Soups made entirely from bone or joints are rich in gelatine, and hence must be considered as gelatine food.

Soups in the making of which no stock is used are divided into two classes, known as creams and purées.

The first class are made of milk combined with some of the succulent vegetables, such as potato, corn, tomato, celery, asparagus, and the like. Their nourishing properties reside chiefly in the milk and butter used in their composition. They are light, easily digested and much to be commended as a form of food for both young and old, and are to be withheld only in those cases where milk is contra-indicated.

The second class, the purées, are made from peas, beans and lentils only, because these are so rich in a substance known as legumin, which is simply a vegetable caseine. This is as nourishing as the caseine of milk, and hence these leguminous seeds are the best suited, by their composition, to replace animal food, containing, as they do, much starch also, which is the necessary carbo-hydrate that nature requires. The purées are nourishing, strong food, adapted to the wants of growing children and people of good digestion, as well as of invalids.

A proprietary preparation known as revalentia has long been sold, especially in Europe, as particularly suited to invalids. It is composed of pea, bean and lentil flour, to which some corn meal is added. The testimony of those familiar with its use speaks highly of its digestibility and nourishing properties in almost any kind of invalidism. The flavor of the lentils is unpleasant to many people, which constitutes an objection to its general use. The split pea and the black

bean, from their agreeable flavor, make the best purées, and are also the easiest of digestion of this class.

In our definitions it has been stated that fat might be considered as concentrated sugar, and sugar as concentrated starch. This definition shows at once the place sugar occupies as a food. It is a heat and force producer, less valuable, weight for weight, than fat, but more concentrated than starch. In fact, all starch is converted during digestion into a sugar known as glucose, for in this form alone can it be assimilated; into this form of sugar, all kinds of saccharine substances, cane sugar, sugar of milk, grape sugar and the like, must be converted before they can be absorbed.

This change is effected in the small intestine and all the glucose there absorbed is taken to the liver for a final change into glycogen, which is then utilized by the blood as required. The change from sugar into glucose is quickly made in the intestine, and the first point to be guarded against in using sugar is overloading the liver with glucose faster than it can be converted into glycogen. The sugar not utilized is especially liable to rapid fermentation and the formation of acid, with all the attendant harm resulting from it.

As was remarked in Chapter I., nature needs no commercial glucose, and she will not accept it as a substitute for the natural kind. It only

remains to repeat here that as an element of food all commercial glucose should be eliminated from the diet. A person having a normal starch-digesting power requires no additional sugar for food, because its use is liable to the dangers heretofore pointed out, of fermentation and liver obstruction. In Bulletin No. 13, U. S. Department of Agriculture on "Foods and Food Adulterants," part 6, it is stated, "Not a single sample of the twenty-five candies examined consisted of pure cane sugar. They were all mixtures of cane sugar, with commercial glucose, or starch, or both."

Concerning the analyses of molasses and syrups, as given in the same work, the report of Mr. Nicholson says that 70 per cent of the samples analyzed by him contained glucose. Mr. Weechman, who analyzed twenty-four samples of New Orleans molasses, found 66.7 per cent were adulterated with glucose. The use of candies and syrups in general, therefore, cannot be recommended, and they are especially likely to be harmful to children, for, besides the direct injury they may do, all sweets have a secondary effect — that of cloying the appetite, thus preventing growing bodies from taking a proper amount of nourishing food.

When grape sugar is eaten in a large quantity, it can be found unaltered in the urine, showing that nature is taking more than can be utilized. This condition cannot continue long with-

out serious injury to the eliminating organs. Cane sugar cannot be absorbed as such; it requires to be acted upon by a digestive principle, found only in the small intestine, which converts it into glucose for absorption. It is reasonable to suppose that nature will not convert and absorb more cane sugar than the system requires, hence cane sugar is much safer for use than grape sugar, because it permits nature to do her own chemical work, which, as was said before, is an essential point in normal nutrition.

It is found that sugar is a very fattening element of food, and is a very palatable form of introducing fat into the body in those cases where this is lacking. Pure cane sugar in the form of rock candy, and nature's glucose, as found in dates, figs and honey, are the only forms of saccharine food which can be safely approved, but there is more danger of too much being taken than too little, under any circumstances.

Sugar is always to be regarded as an acid-making food, and a close watch must be kept on the excretions to determine whether it is being taken in excess. Sugar, from its pleasant taste, is likely to induce a habit manifesting itself in candy-eating, and this is a two-fold evil, first from the harm done by the sugar, and second, the injury caused by the endless adulteration of flavors and ingredients, from which it is safe to say no candy is free. Hence it cannot be recognized as a food in any sense.

In treating of albumen, it was noted that though this is the one important substance with which nature performs her functions, it is not possible to use it alone for prolonged and complete nutrition. Neither is it possible to sustain life, beyond a certain period, on fat alone.

Turning to the vegetable kingdom, we find there a substance known as gluten, the nitrogenous element of the food cereals, which, taken as a food, satisfies, by itself, all that nature demands for prolonged and complete nutrition.

Gluten and water then, constitute all that is necessary for food and drink. It is a mistake, however, to consider gluten as a single food element. It is a compound of four different food substances, identical in composition and food value with those substances found in the animal kingdom. These elements are, first, vegetable albumen; second, vegetable caseine; third, vegetable fibrin; fourth, vegetable gelatine.

The absence of fat from gluten, with the presence of this vegetable gelatine and the fact that it satisfies all the demands of nutrition, throw strong confirmatory proof upon what was said previously regardng the office of gelatine in nutrition that its office in nature is that of an albumen-saving food; and the use of gluten seems to settle beyond doubt that it is possible for nature to form fat from the albuminates. To demonstrate in practice the true value of gluten as a food, let us call attention to the fact that in

many of the cities of Italy the laborers make this their staple diet.

Pure gluten, in its different forms for food, has not been made use of nor received the attention it deserves in this conutry. Its use has been limited to that of an ingredient in soup, or else it is cooked with cheese or tomato, and taken more as a relish than for its nutritive properties.

Gluten food is available in four forms, macaroni, vermicelli, spaghetti paste and alphabet noodles. The macaroni and spaghetti paste are well adapted, combined with tomato or cheese, for baked dishes. These are especially good for adults, while vermicelli and alphabet noodles, boiled plain and served with cream, are admirable dishes for children or those having feeble digestion, and may very wisely replace the morning dish of cereals, being even easier of digestion and far more nourishing than any of these. It must be remembered that in gluten there is practically no indigestible or waste matter, and the bulk eaten should not be over one-third the bulk taken of cereals.

There have been "meat cures," "grape cure," "water cures," "whey cures," "milk cures," "stuffing cures," and "starvation cures." It has long been a matter of surprise to the author that a "gluten cure" has not been instituted, for if there is any one article of food which is free from all objections, it is gluten. After a very extensive series of observations

made in the use of this food, the writer commends it very highly as a non-acid-making, non-fermenting food, and feels justified in asking physicians to give it a thorough trial.

There are many brands of gluten food on the market which are not desirable, being made from unsuitable varieties of wheat, containing too much starch or other undesirable ingredients. This is the objection to all gluten flours. The purest gluten will be found in the imported alphabet noodles. If it seems desirable in certain cases to save nature the labor of forming fat from the albuminates, the addition of fat in the shape of cream or butter to gluten food will accomplish this end.

The remark has just been made that gluten, as a food, is free from all objections. This is true, but the writer has found in practice that many persons, more especially those who have not been accustomed to this food when young, complain that they become tired of it after a short time. This objection is removed in the case of a food called "leguna," which is a combination of gluten with grains in a scientific and proper form. It has a peculiar taste, which is probably due to the very valuable element of legumin in it, but this taste those using it, old and young, soon become fond of, and its constant use is thus assured. It is, as the writer can testify from practical tests in many cases, just what is claimed for it, namely, a food containing all the nourishing and strength-

giving elements of all other cereal foods combined in one, and is a bone, flesh and fat maker. It is recommended for old and young, and is equally adapted to strong or feeble stomachs. It is a valuable addition to our foods because it is a practical, as well as a scientific combination.

In Arabia, Egypt and India, millet is said to have been the first grain used in bread making, and it is still in use. The first bread grain used in Europe was oats; barley and rye next came into use for this purpose, and lastly wheat, for it is only within comparatively recent times that wheat bread has come into common use. One hundred and fifty years ago even the wealthy families of England used wheat bread only at Christmas time, oat cakes furnishing the staple bread for the remainder of the year.

The making of bread differs greatly in the different countries where it is used. In some countries it is baked but twice a year, in the form of loaves or in flat disks, and is eaten only after it has become dry and hard. In others it is freshly baked every day, and never eaten when more than a day old. Coming to wheat bread, as it is used among us to-day,it is found that the flour used is made by a comparatively new method of grinding, known as the roller-mill process, instead of the old fashioned burr stones. Whether the flour made in this way is better than that prepared by the burrs, is an open question. By the use of the mill-stones the flour was coarser

and much of the bran was left in, and hence it more nearly resembled whole wheat flour. By the roller method the grain is converted into a superfine flour, and the greater amount of the outer part of the grain, containing a large proportion of mineral matter, is removed by a process called "scalping." Leaving the question of the effect of bran on the flour out of consideration, let us consider bread as a germ-carrying, microbe-breeding food.

It may seem like heresy to intimate that bread, which is so universally called the "staff of life," is open to criticism; and that we should attribute some of our ailments to bread-eating may excite surprise. That such is the fact, however, will be made plain by considering existing conditions.

In the making of bread, some one of the microbian ferments known as yeast is used. The whole subject of yeast has been discussed in a previous chapter, and what is there said must be borne in mind as applying to bread in a greater or less degree. The compressed yeast so largely in use to-day certainly produces bread of a different flavor from that made by using baker's or brewer's yeast, which was in use before compressed yeast came upon the market. It is thought that the heat of baking destroys the vitality of all micro-organisms which are in bread. This is not a fact, for the yeast microbe can be cultivated from the center of any freshly and apparently well-baked loaf of bread, but there

are other micro-organisms which may find lodgment in bread, and the effect of heat on these germs has so much to do with the question of sterilization that we quote in full the results of some investigations lately made in London by Drs. F. J. Waldo and David Walsh. They made cultivations from sixty-two loaves of bread, taken from various bake-houses in London. Some one or more of thirteen kinds of bacteria were found alive in all these loaves. Here is the list:

Bacteria (or their spores) found in a living condition in freshly baked loaves of bread: bacillus subtilis, variety 1 (hay bacillus); bacillus subtilis, variety 2 (hay bacillus); bacillus subtilis, variety 3 (hay bacillus); sarcina (a) large; sarcina (b) smaller than (a); bacillus A (large, thick, rounded ends); bacillus B (large, thick, smaller than A); bacillus C (small, copious spore formation); bacillus E (bacillus figurans); micrococcus A (small white colonies); micrococcus B (rosaceus); staphylococcus (very regular, larger than staphylococcus aureus).

From a number of experiments made on loaves baked in a small laboratory oven, it was found that the average maximum temperature in the middle of an ordinary quartern loaf during baking varies from 163.4° to 186.8° F., and in small loaves from 186.8° to 203.2° F. There is a steady increase of temperature in the center of any loaf during baking; thus in a quartern loaf during one hour it rises from 25° to 75° C., and

in a half quartern loaf from 25° to 88° during the same time. For the first forty minutes the maximum temperature is probably not more than 48° or 50° C. The practical inference is that any organisms that might be present in the center of a loaf would be exposed for a short time only, during baking, to a maximum temperature of 73° to 86° C. (163.4° to 186.8° F.) in a quartern, and of 86° to 95° C. (186.8° to 203° F.) in a half quartern loaf.

It is known that most bacteria are destroyed by an exposure to the temperature above mentioned as the average for the center of a loaf during baking. The death point of bacteria has been generally expressed by Koch and Wolfhugel in the following passage: 1. Sporeless bacteria are destroyed in one hour and a half by hot air at a temperature slightly exceeding 100° C. (272° F.) 2. Spores of fungi require one hour and a half at 110° to 115° C. (230° to 239° F.). Spores of bacilli require three hours at 149° C. (252° F.) It should be noted that these statements apply to dry heat only. In the middle of the loaf there is presumably moist heat, which is, of course, more destructive to organisms, and on that account a considerable reduction should be made in the figures of Koch when we apply them to fungi and their spores inside a loaf.

The authors draw this significant conclusion:

"We see no particular reason why the origin of many mysterious septic invasions of the human

body may not eventually be traced to the agency of bread. A generation ago milk was not suspected of being the means of spreading disease, and a similar observation applies to water. At any rate the subject dealt with in this paper seems to us to be well worthy the attention of all who are interested in the scientific development of preventive medicine, no less than in a protection of the public that consumes the bread."

It is plain then, that in all conditions of acid diathesis or acid excretions, or of a fermentative state of the alimentary tract, we must use a sterile form of bread, or sterilized bread. From the experiments detailed above, it is evident if the loaves are made very small and so thoroughly baked that there is a large percentage of crust, and the middle of the loaf has been subjected to a high temperature, the danger of there being living micro-organisms or their spores in the bread, will be overcome.

Toast has long been accepted as proper food for invalids and those with weak digestion. Its value lies in the fact that it is a sterile bread. The German zweiback comes under the same head, and is a wholesome substitute for fresh bread. Another more elegant form of sterile bread and one which is adapted to the use of young or old, is bread sticks. In making these the dough is rolled so thin and cut into such narrow strips that when ready for the oven they are

not much larger than a lead pencil, and hence the baking is sure to destroy all yeast and other germs, and, the whole being so largely converted into crust, the starch is rendered very easy of digestion. A desirable form of bread is sold in the stores under the name of pretzels or pretzelettes. The dough in these is first boiled and then baked, and by this double process they are made easy of digestion and positively germ-free. This form of bread, particularly the pretzelettes, is an admirable one for children; the fact of their hardness makes it impossible to eat them too rapidly, and the thorough mastication they require, causing a free secretion of saliva, is a very important aid to perfect digestion.

Crackers may be regarded as a sterile form of bread. The first objection to them is that the dough is baked in such a dry state that the starch granules, being deprived of water, are not broken enough to make them wholly digestible, and this is an important matter affecting all starch foods. They require to be thoroughly cooked with a sufficient quantity of water present to enable the starch granules to absorb this, thus softening and breaking up the cell structure, which is disintegrated and thereby rendered digestible. Crackers, too, from their brittleness, are not likely to be thoroughly masticated before being swallowed. Again, on the raw starch which they so largely contain, saliva has no very marked sugar-making

power, nor has the pancreatic juice, as we have shown; hence a great portion of the cracker, in the form of raw starch, finds its way through the alimentary canal (this is particularly true of oat meal crackers), and accumulates in the large intestine, thus explaining the constipation that follows the eating of crackers to any extent. Crackers, for this reason, then, should not be given, in any quantity, to children or to any one troubled with constipation.

Baking powder biscuits are a sterile form of bread, and, when toasted, they make a good article of diet for those having fermentative dyspepsia.

Mention has been made of the necessity for starch being thoroughly cooked to fit it for digestion. There are numberless forms of starch and starch granules and they vary greatly in form and hardness; some kinds, notably those of oat meal, may be taken as a type of the tough starches which require long cooking to be easy of digestion, while tapioca and sago are examples of the tender and easily digested starches. All kinds of cereals vary, therefore, in the time required for cooking. As they are lacking in fat, they should be eaten with cream or butter. Sugar or syrup should not be eaten with cereals, because the starch in them is, by digestion, converted into a form of sugar, and any added amount would probably be in excess and overtax the liver, as was shown when discussing sugar.

In defining vegetables as distinguished from fruits, it will be remembered that there seemed to be a natural division marked by the almost entire absence of acid in edible vegetables. In fact, the rhubarb stalks and the tomato are the only vegetables in general use containing any free acid. The rhubarb is properly a medicinal plant, and its use in Europe as a food is almost unknown. In Germany it is cultivated as an ornamental plant. The excess of acid it contains, free and combined, and the fact that the acid is oxalic, makes it doubtful whether it should be retained among the edible vegetables. The writer considers it unfit to be eaten, and therefore it will not be considered in this discussion.

This leaves the tomato as the only edible vegetable having any acid in its composition, and the amount it contains is very small, being mostly in the form of an oxalate of lime. On this account it is claimed that the tomato should not be used by those having the gouty diathesis. The writer must say that, as the result of his experience, he has failed to find in practice any disturbance of the digestion caused by the use of the tomato. It is particularly harmless, and even beneficial, when used in its fresh, ripe state, and without the addition of vinegar. A mayonnaise dressing may be used on this and other vegetables. This, when properly prepared, contains so small an amount of acid that it is accepted by most stomachs without causing any

derangement, the fat globules of the oil or cream, in the dressing, modifying the action of the acid. Tomatoes stewed and eaten alone, or as an ingredient in macaroni and other dishes, are free from objection as far as known. The use of any food containing acid for growing children, however, must be carefully watched, for reasons already given.

Many vegetables eaten cooked or in the raw state are valuable for the organic form of the saline elements they contain, rather than their nourishing properties, which in most cases are represented by a very small fraction. The potato so universally used is very poor in nourishing properties. It would take fourteen pounds per day, it is estimated, to sustain the life of an individual, but as an element of diet, it is an acceptable form of starchy food, and is chiefly valuable by reason of retaining its freshness so long and well. It, therefore, is a leading antiscorbutic food, and after a child has its full complement of teeth, the potato, either baked or mashed, may very properly have a place in its diet.

Concerning the use of all vegetable foods, both fresh and dried, whether cooked or raw, it is unnecessary to say more than that from their structure differing so widely, their digestibility must be measured by the absence of a tough or cellular structure in them. The rule of common sense must apply as to which kinds shall be used and by whom. The taking of too many kinds of

vegetables at one meal is objectionable, owing to their different degrees of digestibility, and, in the use of vegetables, individual peculiarities and idiosyncrasies must be taken into account. The pepo family, to which belong the pumpkin, the squash, often called "vegetable marrow," the melon and the cucumber, constitute an important and valuable class of vegetable food.

Musk melons and water melons, when allowed to ripen on the vines, and eaten fresh, may be freely used without harm. They contain ninety-five per cent of water combined with saccharine matter, which latter constitutes their only nutritive value; but they are free from indigestible elements, and are not prone to fermentation in the stomach. Melons are among our oldest vegetables, originating in Turkey and Arabia, where they have formed an important part of diet for centuries.

The cucumber, although eaten green, does not deserve the bad reputation it has acquired. When eaten before the seeds are hardened, fresh from the vine, and without either vinegar or soaking in a salt bath, which wilts and toughens it, it is more wholesome, nourishing and digestible than the apple. The cucumber has for centuries been held in high esteem and formed the staple diet of the people of Persia and other eastern countries. Pickled cucumbers should never be used, as the process hardens the albuminoids and renders them very indigestible.

Among the raw vegetables in general use, as the radish, the tomato, and the cucumber, the skin is removed before eating, thus eliminating the danger of introducing unknown microbes into the system. In the case of celery and water-cress it is worthy of remark that, by virtue of their composition, they are free from microbes, and hence their use is not contra-indicated for persons having fermentive dyspepsia. In fact they may be said to have germicidal powers, therefore are often beneficial in such cases. Lettuce, on the contrary, is a microbe bearer, and we must not think that washing renders it sterile. Every time it is eaten there is certain to be introduced into the stomach a large number of microbes, and, as before remarked, we cannot be sure they are harmless. As we have been advocating in these pages the importance of sterile food and drink, it follows that we cannot sanction the use of lettuce, certainly not by those having any tendency to digestive disturbance.

All vegetables, as a class, tend to increase the alkalinity of the blood, and hence must necessarily constitute a leading element in the diet of those having the acid diathesis, as shown by the acidity of the excretions.

All grains and food made from the starchy and sweet vegetables are, in general, fat makers, therefore they are best omitted, as far as possible, from the dietary of very fleshy people, Such persons should eat only lean meat and suc-

culent green vegetables, avoiding sugar and fat. For lean people, on the contrary, a dietary made up of all starchy foods, fat meats, and free fat, as in butter and cream, is desirable.

It is unnecessary to go into further details. Enough has been said to make plain the object of these pages, which is to show that neither microbes nor acid nor acid-making food and drink have any necessary place in digestion or nutrition. On the contrary, all these have a tendency to interfere to a greater or less extent with nature's normal processes. That some persons partake regularly and freely of such substances in their food and drink and are apparently none the worse for it, does not meet the argument. Certain it is that persons with a hyper-acid tendency or condition of the system will find here reasons enough to convince them of the wisdom of exercising great care in the use of acid and acid-making and microbe bearing food and drink. To those having the care of children, this remark applies with increased force, for by errors in a child's diet its growth and strength may be so seriously modified as to impair its health for life.

In speaking of fruits in a former chapter the subject was treated from a scientific point of view, taking into consideration their composition and the food value of their ingredients with reference to their effects on digestion and the blood.

Leaving the domain of science, we shall now discuss a view of the subject which may be

termed nature's side of the question, and we shall give another classification of fruits which tends to confirm the truth of our scientific conclusions.

In this we classify fruits into natural food fruits and cultivated fruits; under this arrangement will be found marked differences. The first fact is that the natural food fruits are all nourishing and free from digestion-inhibiting effects. The second fact is that those fruits which man has developed from wild, unpalatable varieties, which never were intended as food for man, into edible forms, are likely to produce abnormal conditions of digestion and interfere with nutrition when used as food.

Let us illustrate this point. The date, the banana, and the fig, are true examples of natural food fruits; they are to-day simply wild fruits. Man has not, by any process of forcing seedlings, cross-fertilizing, or grafting, changed their form, or natural composition, or flavor; they are to-day the same fruits; that is, have the same combination of substances in them as first made by the Creator, and are, as we have shown, admirably adapted to man's use as a food, and are plainly intended for his use as such. It is interesting to remember here that all the edible fruits of the tropical region, such as the custard apple, the guava, the mango, the durian, and the mangosteen, are natural and indigenous fruits,

and many of them refuse to be transplanted from their wild home. Those that submit to care or cultivation by man do not lose their original characteristics, but remain the same in composition and elements as in the wild state. The cocoanut, also so largely used for food, is unchanged in the slightest degree by any efforts of man.

Considering next the wild grape, the wild plum, and the wild crab apple, we find these in their natural state producing fruit that contains an excess of free acid, as well as tannin and other substances, which properly exclude them from consideration as food for man, plainly showing that nature did not intend them to be so used. Man, however, by forcing seedlings, grafting, and assiduously cultivating under artificial conditions, has modified these fruits so that they are very acceptable to the palate, and he has to some extent eliminated the objectionable acid and other unpleasant ingredients, but has not been able to make a proper food of them, as actual experience proves. That these fruits are practically abnormal or forced variations is plainly shown by the fact that all these cultivated varieties, when allowed to run wild, at once show retrograde tendencies, that is, the fruit returns to the natural sour and unedible form of the wild variety.

These cultivated fruits, developed from fruits never intended for food for man, are unnatural combinations of the fruit elements and are, there-

fore, prone to cause digestive disturbances when taken into the stomach. In effect they resemble artificial food. Here again is confirmed that law to which we have referred, that nature is intolerant of any but her natural combinations in substances intended for food for man. How hard it is to force these fruits from nature's kind into palatable forms is made very plain when we remember that of ten thousand seeds of the choicest varieties of the apple which may be planted, it is found that only about one out of the whole number of these fails to show retrograde changes which make the fruit utterly worthless.

Then again, it is well known that, if any of the choicest varieties of the apple are allowed to run wild, the fruit soon becomes hard, woody, and unfit for use; in almost all instances the branches of the tree will produce thorns like its wild progenitor, the crab apple. Nature seems ever ready to undo the work that man has accomplished by much toil, and thus seeks to protect him from the injurious effects of his own work.

The orange, like the apple, is a product of man's art in cultivation. It is estimated that he has brought it to its present condition from the wild, bitter, and unedible variety by twelve hundred years of attention. The tree, however, still shows its tendency to revert to the primitive type, and requires constant cultivation and care to keep it from degenerating. If once allowed

to become wild, the fruit, as is well known, speedily becomes bitter and unpalatable. The orange, then, is not a natural fruit, and the same remark applies to the lemon. The pear, having much the same structure as the apple, is even more prone to degenerate than the latter. There is a wild spine-bearing pear tree common in English woods, that is known to be merely the tame variety run wild.

The peach, one of our oldest fruits, is said to have been originated by the Chinese, probably from the wild almond. Chinese works dating ten centuries before the Christian era have a distinct name for the fruit, thus vouching for its antiquity. Still we must class the peach with the cultivated fruits, the apple, the pear, the plum, the orange, the grape, and the lemon, and the reason is this: none of these fruits can be reproduced from the seed true to kind. The pit of the choicest peach, if planted, produces a tree, the fruit of which is nothing like the parent, but is hard and sour in its first bearing. All these cultivated fruits referred to can only be maintained in their high state by grafting, budding, or layering, while the natural fruits reproduce their kind at once from the seed or shoot. This is in itself an evidence of the unnatural condition of the cultivated fruits.

The fruits of the progenitors of all the cultivated varieties to which we have referred, are sour

and bitter; man, by his cultivation, has increased the saccharine matter in their composition. In the case of the strawberry, exactly the opposite is true. The wild variety is deliciously sweet, tender, and with a peculiar flavor of its own, while the cultivated varieties, notably the Wilson, are intensely acid and almost entirely free of any strawberry flavor. This may also be truly characterized as a marked example of harmful changes obtained by cultivation. This view is confirmed by the fact that many persons find they cannot eat the cultivated strawberry without having digestive disturbances. This changing, by man's skill, of a sweet fruit to a sour, or of a sour fruit to a sweet, would seem to show that nature resents man's interference with the combination of elements which she has introduced into her natural fruits. In the words of Dryden:

"God never made his work for man to mend."

Nature's resentment to interference would seem to be further exemplified in the fact that the flesh of wild fowl and game is much more easily digested than that of the domesticated varieties.

In closing these pages, the author wishes to emphasize the fact that all he has said is intended as a warning. To this end, as conducive to good health and long life, and as guarding against acquiring digestive disturbances, which

we may leave as an inheritance to our children, he urges the importance of using those things for food and drink that nature designed we should. Just to the extent that we use man's digestion-destroying modifications of nature's true foods and drinks, and yield to an acquired or vicious appetite, just to that extent we interfere with our health and well-being.

INDEX.

A

I

J

K

L

M